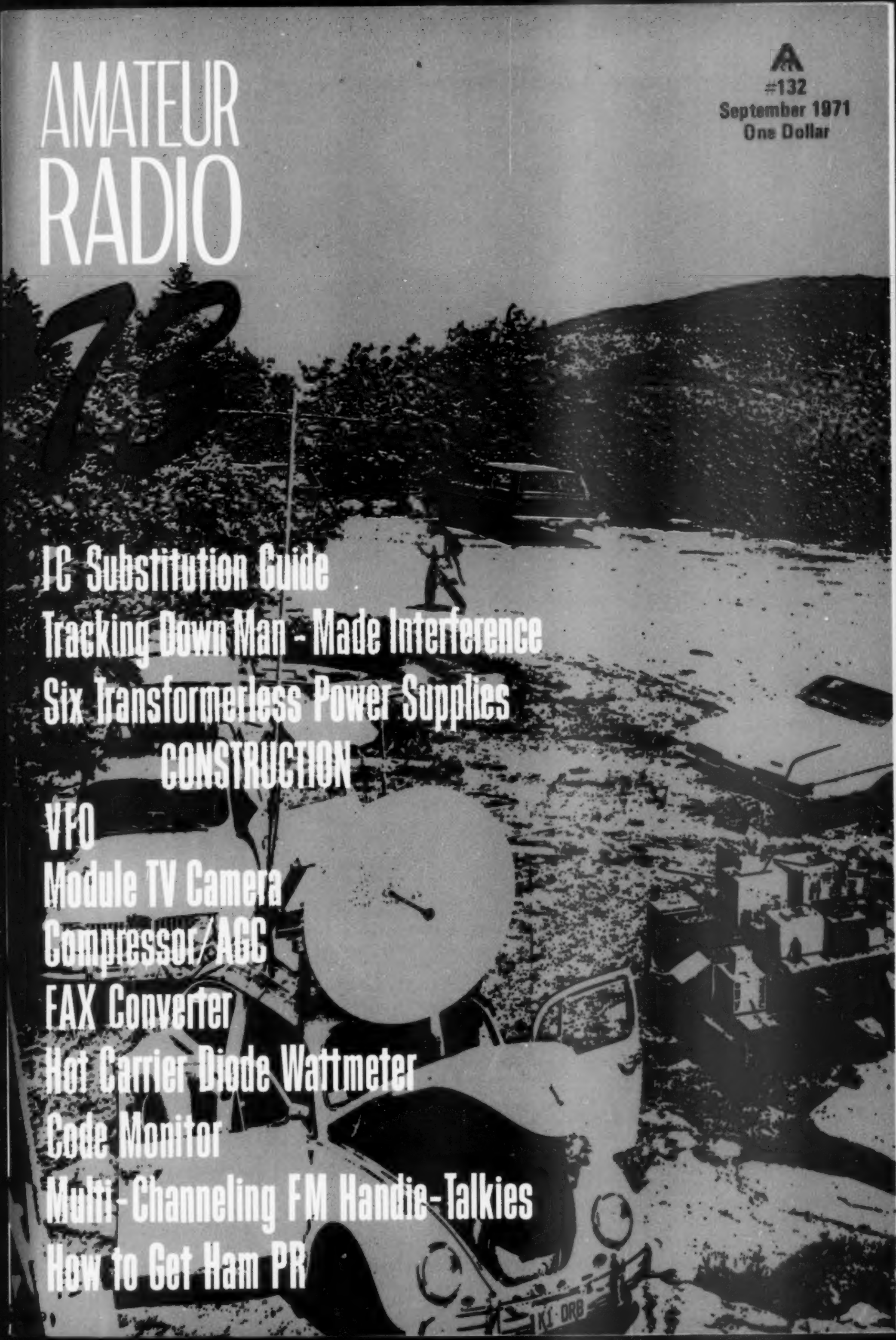
73 AMATEUR RADIO

#132
September 1971
One Dollar



IC Substitution Guide

Tracking Down Man - Made Interference

Six Transformerless Power Supplies

CONSTRUCTION

VFO

Module TV Camera

Compressor/AGC

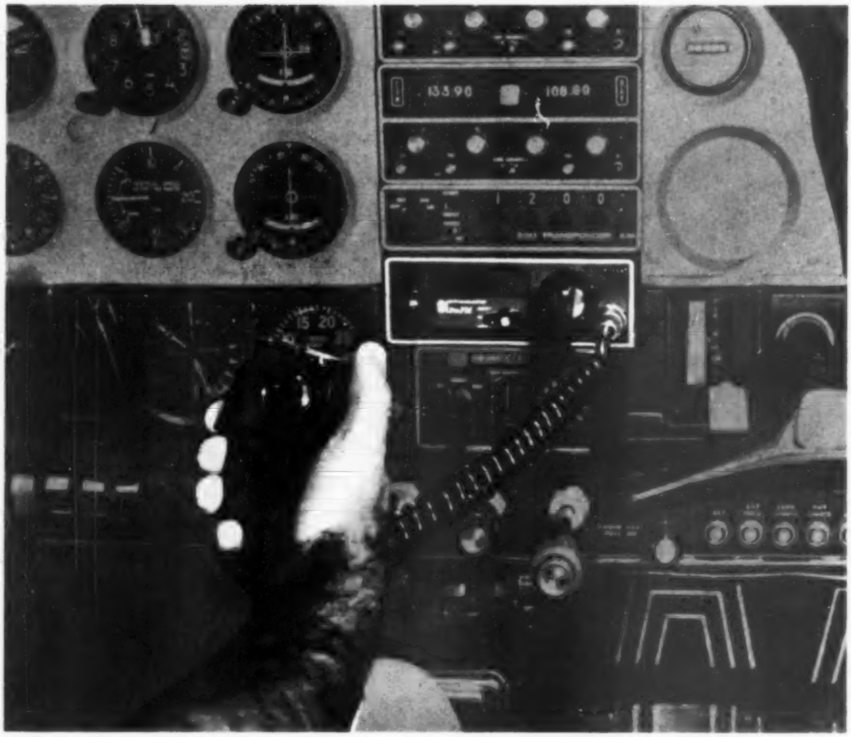
FAX Converter

Hot Carrier Diode Wattmeter

Code Monitor

Multi-Channeling FM Handie-Talkies

How to Get Ham PR



Standard's New High Flying "826"

Standard Communications, the world's largest manufacturer of VHF marine equipment, has developed a professional quality VHF/FM 2 meter transceiver especially for amateur use. The "826" is so compact that it makes mobile installations practical in almost any airplane, boat or car, and it becomes fully portable with Standard's battery pack. When used in conjunction with the AC power accessory, it also makes an ideal, low cost base station unit. Enjoy the fun of amateur radio communication wherever you go for just $339.95.

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73 MAGAZINE

#132 SEPTEMBER 1971

CONTENTS

FEATURES

2 Radio Amateur News Page
4 Never Say Die W2NSD/1
4 Leaky Lines K2AGZ
6 Novice
8 DX Footnotes
8 New Products
10 Letters
12 Caveat Emptor
58 Code Monitor
106 Band Monitor
120 Astro Mike Test
128 Propagation
128 Advertiser Index

14 Transformerless Power Supplies K3SVC
Theory and six practical circuits.
18 Build a Solid-State Module TV Camera W0KYQ
And amaze your friends.
28 An Experimenter's Guide to IC Substitution K5JKX
Getting HEP to IC's.
38 Microwaves and Microsounds K1CLL
How to see underwater.
42 RF Power Measurement with Hot Carrier Diodes W6AJF
Rf wattmeters for up to 450 MHz.
47 IC/Photocell Compressor/AGC Unit W2EEY
With no noise buildup problems.
52 The Theft Stopper K4EPI
Booby trap for the car.
53 A Marketing Man's Approach to Ham Radio WB8CDU
Ham radio is a product.
59 Multi-Channel Operation with the Motorola HT-200 . . K8YQH
HT-200 modification.
66 Facsimile for the Radio Amateur: Part II .... Dean
Scan this thriller continued from last month.
78 Man-Made Interference WB5DEP
Its causes and cures.
86 A Linear Stable VFO W8RHR
Better a VFO than a UFO.
89 General Class Study Guide XII .... Staff
Some general questions on TVI, etc.
101 Effective Heat Sinking K5ZBA
Preventing fried germaniums and silicons.
104 The Spider W4RIZ
Interfacing your transceiver and linear.
107 "Say Coo, Say Coo, Day Eckees" W7OXD
Some hams don't speak English.
112 An IC Pulser for the Amateur Experimenter W6GXN
For the many unpulsed IC's around.
117 A DC Isolator for Phone Lines .... Weinstein
Keep out of trouble.
119 New Hope for Learning the Code WA1KWJ
Learn the code in two hours.
122 73 Tests the Gonset Super Scan Receiver W2NSD
Minding 8 FM channels at once almost.
124 New Mark Products $30 Battery-Boost Regulator ..... Brown
Works from 11 volts up.

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What good can possibly come of your buying products not advertised in 73? Why take chances? If they were any good at all, wouldn't they be advertised in 73?

Cover: Posterized print of the VHF Contest effort by the Waltham Amateur Radio Club on Pack Monadnock in Peterborough, N.H. this last June. Credit Roger Block with the effect if you like it.

Amateur Radio News Page

SEPTEMBER MCMLXXI Monthly Ham News of the World 73 MAGAZINE

CINCY TOWER VICTORY

Hams can breathe a little bit easier after another favorable ruling in a tower case recently settled near Cincinnati. Carl Dettmar, W8NCV, of Finneytown, Ohio, applied to the Hamilton County Zoning Board for a building permit to erect a 64-foot tower in his back yard. Although starting out with the consent of his neighbors, his original request was refused. While appealing this decision some of his neighbors withdrew their consent and the board raised the question of TVI. Carl replied to the TVI inquiry that he could not guarantee that there would not be TVI, but he would work with anybody affected should the problem arise.

Carl's appeal was rejected unanimously by the board.

At this point Carl contacted Ben Turpen (W8CQM), a local attorney, and they agreed to take the matter to court. Realizing the importance to other amateurs around the country as well as hams in the immediate area, the Greater Cincinnati Amateur Radio Association agreed to pay the court costs.

In May of 1971, approximately one year after Carl's original permit application, Judge Gilbert Bettman of the Hamilton County Common Pleas Court ruled that because amateur towers are not specifically excluded by the area's zoning restrictions, and as long as ham radio is a legitimate family hobby, Carl could erect his tower. The judge continued, "We find nothing in the zoning resolution making Dettmar's proposed use unlawful. The fact that not many people have amateur radio antennae no more precludes their use than the fact that not many people have tennis courts precludes their use."

Hams around the country might all thank Carl, Ben, and the GCARA for their time, money, and perseverance.

"WORLDRADIO"
HAMS HELPING HAMS

"After twelve years as a ham I think there has to be something more challenging than "S" meter reports and comparing tower heights, over and over and over again." Perhaps we, have all felt this way once in a while, but the man who spoke these words

zations mentioned. Nobody on *Worldradio* receives a salary, except for a few clerical helpers. *Worldradio* is trying to be impartial and to avoid conflicts, yet its pages are open to all.

Worldradio

WITH THE DX YACHT "REVERIE"

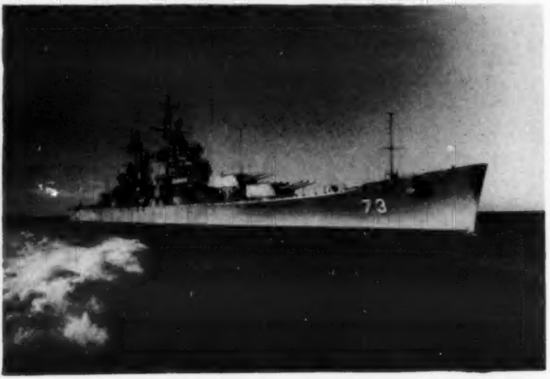
Leaving Annapolis, Md., the *Reverie* passed buoy 73 and hauled up the signal flag 73. Skipper Tex Zammit, K4MJZ, and yachtsman Steve Titus, were ten miles closer to the start of the 73 DXpedition.

Following the Annapolis departure on July 3rd, the *Reverie* stopped in Oxford, Maryland at the Phillip Morris Inn for what Tex maintains is the best bowl of She Crab Soup in the world. Ham yachtsmen may know Oxford as the beautiful little harbor town where the clock seems to have stopped over a century ago. It is a popular rendezvous for larger yachts.

After a cautious sail around the ship graveyard – Cape Hatteras – Tex and Steve proceeded to West Palm Beach, Florida, where they spent the rest of July stocking the *Reverie's* larder and making final repairs and adjustments.

Upon arriving in Florida, Tex got the first few of his Caribbean ham licenses in order. These include permission to operate in the Bahamas, British Virgin Islands, and the Caicos and Turks Islands.

Make sure you have sent in the DX coupon on page 55 of last month's 73 with the DX you would like to see activated. Make certain your rig is



73 BIG GUNS

High officials at 73 Headquarters in the remote wilds of New Hampshire refused to deny the consistent rumor that the magazine will soon be published from a new floating headquarters ship. It is understood that the Coast Guard has expressed some concern over the recent exercises well off the New Hampshire shores by the 73 crew.

Wayne Green has flatly denied that he has any intention of anchoring the new 73 headquarters ship off the coast of Long Island within gun range of Port Washington or that any harm has been threatened to the CQ Luxury Yacht from which Cowan directs his publishing empire.

Green has evasively hinted at using the ship for DXpeditions to some of the rarer islands around the world, but inside word has it that Cowan has secretly been arming his yacht to the teeth and that the beleagered group at Ham Radio have been bidding on a used rowboat so as not to be left completely behind.

CLUB HELPS CHILDREN
VERBAL CRIPPLES COMMUNICATE

Non-verbal children are able to make audible sounds, but are unable

and over and over again. Perhaps we, conflicts, yet its pages are open to all. coupon on page 55 of last month's 73

have all felt this way once in a while, but the man who spoke these words did something about it. Armond Noble (WB6AUH) started *Worldradio* to help people.

And many dedicated fellow amateurs have come forward to work with him on *Worldradio*.

Worldradio is a new newspaper based on the premise that ham radio can be a resource for good and increased understanding around the world. Armond, a professional journalist whose work has been featured in *Time* and other leading magazines, has gathered a group of other prominent hams and ham-journalists to put out a newspaper to feature the positive, the good, the life-saving, and the human aspects of our hobby. This all reflects Armond's view, "What a wonderful thing this communication. And how much more challenging and fulfilling when used for a real purpose."

Worldradio has a sterling list of purposes. Included in the activities which *Worldradio* is supporting with money and coverage are Airmen's Memorial School on New Britain Island (run by Fred W0EBG/VK9FH), Amigos de Las Americas – a youth oriented person to person program in Latin America, International Mission Radio Association, and the Minh-Quy Hospital in Kontum, Vietnam (a continuing program with Steve Olson W6EQM). Other groups include the S.S. Hope and Handi-Hams – a group of W0-land hams who teach ham radio to blind and handicapped people. And there are more. *Worldradio* is also trying to build up a reserve of money to facilitate the purchase and shipment of needed medicines when a call comes in via ham radio for a needed medicine anywhere in the world. Yet another aim of the organization is to lend equipment to doctors, missionaries, and others who are traveling to areas where ham radio would be a vital tie to the outside world.

The spirit of helping other people via ham radio is, of course, a long tradition in our hobby. *Worldradio* though, is a new type of publication. Published every three weeks, it costs $5 a year in North America and $6 (46 IRCs) elsewhere. Ten percent of the budget is allocated to the organi-

Worldradio
THE INTERNATIONAL COMMUNICATIONS REPORT

They are trying to be positive, constructive, and cooperative – a tall order for any publication. One thing *Worldradio* is not, however, is technical. Armond feels the technical aspects of the hobby are interesting, but not as vital as the more human side of the hobby. And he feels that there is a need for a publication which can turn more people on to the work of teachers, doctors, missionaries, and travelers trying to make this a little better world.

For more information, a sample copy, or to subscribe, you can write to Armond Noble WB6AUH, 2509 Donner Way, Sacramento CA 95818.

There She Is...

The Southern Counties Amateur Radio Association is sponsoring a special events station in conjunction with the Miss America Pageant to be held in Atlantic City, New Jersey in September 1971. The station will operate from 5 September to 12 September. The call WX2MAP (Miss America Pageant) has been applied for. Planned operating frequencies are: CW – 3530, 7030, 14030, 21030 and 28030. SSB – 3915, 7265, 14290, 21365, 28515. Some operation in the Extra, Advanced, and Novice bands is likely.

QSL to Miss America Pageant, Atlantic City, New Jersey, or via K2JOX. Please enclose SASE.

with the DX you would like to see activated. Make certain your rig is working. It should be just a few short weeks before the *Reverie* will be on the air from the Caribbean. Until then, though, Tex is spending August, ". . . cruising around the Bahamas in whatever direction the tide and wind take me."

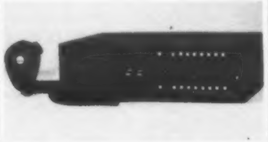
Scanning FM Transceiver

Regency has introduced Transcan (TM) base and mobile transceivers for the 2 Meter FM band.

The receiver section of the radio scans for an active signal on as many as 8 crystal controlled channels. At reception of a signal, the receiver automatically stops to listen to the entire transmission on a given frequency. At the end of the transmission, scanning is automatically resumed. Each frequency can be quickly programmed "in" or "out" of service by a push of the button.

All eight corresponding transmit channels are push button equipped too. When an individual button for the transmit channels is pushed, receiver scan process is automatically stopped and reception facility is locked on the channel paired to the transmitter.

The American manufactured sets boast .35 μV sensitivity for 20 dB quieting, modulation acceptance of ± 15 kHz, and 5 watts audio output with a built-in front panel speaker. Scanning rate is 15 channels per second. Front panel slide controls provide for adjustable volume and all electronic noise compensated squelch on the base unit while knobs are used on the mobile version. Both units, of course, are all solid-state.



Power output of the transmitter for both models is 15 watts across the entire 144–148 MHz bandwidth. Phase modulation with automatic deviation limiting can be internally adjusted from 0–15 kHz.

Model HR-2S 117V ac base measures 13" x 4" x 8½" and is priced at $349. Model HR-2MS 13.6V dc mobile measures 10" x 4" x 8½" and sells for $319. Prices include factory installed transmit and receive crystals for 146.94 MHz. *Regency Electronics, Inc., 7900 Pendleton Pike, Indianapolis IN 46226.*

VERBAL CRIPPLES COMMUNICATE

Non-verbal children are able to make audible sounds, but are unable to coordinate these sounds into meaningful communications. This inability to communicate often compounds the problems of speech therapy by starting off any therapist-child relationship with the child feeling frustrated and sometimes hopeless at his inability to communicate with an adult.

A state hospital in Hamburg, Pennsylvania, developed a technique to overcome this problem by putting a microphone and speaker in a stuffed animal. A child could then talk to the plaything and get replies from the toy – without having to actually face a therapist.

Using this idea, various Western Electric Chapters of the Telephone Pioneers have made talking dolls with 2-way, low power, FM radios. The Oklahoma City Amateur Radio and Electronics Club, an affiliate of both the Western Electric Company and the Oklahoma City Works, worked with the local chapter of the Telephone Pioneers to produce a talking doll for use by the Dale Rogers School for Retarded Children. Along with helping children, the project has generated much favorable publicity for hams and experimenters in the Oklahoma City area.

Other amateur radio clubs might take a hint from this example and see what sort of an interesting and public service oriented project they can evolve.

Joe Hustak and Jim Hiatt with Jackie, "The Talking Doll," a joint venture of the Western Electrical Council of Telephone Pioneers and OCARE.

(Adapted from a news feature in the OCARE BULLETIN, Oklahoma City Amateur Radio and Electronics Club, Summer issue.)

Sub-Audible Encoders and Decoders

Communications Specialists are now distributing a new sub-audible tone encoder and decoder designed for amateur FM applifcations. Compatible with all other sub-audible tone systems, these units come in kit form or already wired and tested. All units are powered directly by 12V dc. Any suitable reed can be used in the kits. All units come on glass epoxy PCBs, are small, stable, and can be used anywhere in the range from 67 Hz to 250 Hz. *Communications Specialists, P.O. Box 153, Brea CA 92621.*

Help the Ham Cause

Most public libraries would welcome donation of used but not obsolete amateur radio books – e.g. last year's Handbook after you get the new one.

NEVER SAY DIE

. . . de W2NSD/1

EDITORIAL BY WAYNE GREEN

EXPO 71

Not wishing to miss anything as important as an Expo, especially after having enjoyed Expo 69 at Montreal and Expo 70 at San Antonio, Lin and I hied off to Chicago with high hopes, to experience Expo 71 as presented by the Chicago FM Club.

Although the hamfest was perhaps just a bit less pretentious than the title, it was interesting and was enjoyed by hundreds of Chicagoland amateurs . . . mostly FM'ers. Belt-portables were everywhere and 146.94 MHz sounded more like a CB channel when the skip is on than a repeater channel.

Expo 71 exhibit area was large, open and uncrowded, making it easy for all to see the exhibits.

There were some mighty interesting exhibits, particularly for the FM operators. Regency unveiled their new units and had their order pads busy when the distributors got a look at the new FM scanner transceiver with eight scanned channels on receive and eight channels for transmitting. What a fantastic gadget this will be in those areas (like mine) where there are several repeaters and simplex channels to be

jinx that has shot down every special interest publication in amateur radio so far, including their predecessor, *FM Journal*. It is, I can vouch, extremely difficult to put out a ham magazine when it is of interest to everyone, and just about impossible when you cater to one special interest, such as repeater owners. Every owner should subscribe to the magazine – it's for you, so *support* it. If you don't support it, you won't have it long. It is expensive to put out a magazine, even when the type is set with a typewriter or it is mimeographed.

Lin meets the 73 readers at the 73 booth.

Mailing is expensive and getting more so. All you have to do is decide to wait a couple of months to see if they make it before gambling your money, and they won't make it. Be fair, subscribe.

The ham manufacturer exhibitors were helped out by several CB and commercial manufacturers such as Midland, React, RCA, Motorola, GE and Hewlett Packard, adding to the general interest of the hamfest. The

ductive possible course of action – and a reflection on the maturity (or lack of it) of the "mad-ee."

For instance, a few months ago when Ken got our little repeater set up on the nearby mountain top, he put it on 34/94 for a few days to test out its coverage. The reactions were interesting. Nearby W1ALE had been active on 34/94 and our WA1KGO repeater overlapped its coverage substantially. Did Ted get mad and raise hell? No, he cut back operation of his repeater to 12 minutes per hour on 34 and opened the 46 input for the rest of the time. This worked fine and there was little interference, even though the repeaters were only 35 miles apart.

Not so cooperative were some of the other chaps. Jamming with RTTY signals and other garbage were dumped into the 34 input around the clock. This was done by repeater operators, not just the users. For the most part the users were the innocent victims of the giant egos involved. Those of you with Freudian leanings may prefer to think of repeaters in that context – hi!

May I offer a suggestion? When the inevitable conflicts arise over repeaters, frequencies, coverage, simplex, and all that stuff that is so damned important that it is almost worth fighting to the death about, how about taking a very simple first step? Come up with a compromise that is equitable to all involved. The next step is to get the combatants together and talk about the compromise. A compromise might involve one group buying up the crystals of another. It might be that both groups could change their repeaters to different channels, leaving the disputed channel for simplex. A compromise cannot be one way. "You get off my channel" is no compromise. Sure, you were there first. Sure you have every right to the channel and the newcomers have no right. Give a little. Maybe you can hook your two repeaters together? Perhaps you can get

LEAKY LINES

by David Mann K2AGZ

If you saw the News Page in the June issue of 73, you are aware that the FCC is reported to be considering an inquiry into Sections 97.39 and 97.107, as well as Section 2 of Article 41, International Radio Regulations, in order to ascertain whether certain types of communications may continue to take place. This entire flap concerning operations such as the Eye Bank Net and Hurricane Watch, etc., focuses attention once again on the perfectly evident fact that there is unbelievable ambiguity and lack of precise meaning in the language of the rules which govern our activities as amateurs. For if the Federal Communications Commission has difficulty in determining the import and thrust of these regulations, how in the world can we individual hams be expected to understand them?

When it comes to situations of an emergency nature, there are no points of confusion or misunderstanding. We know that in those cases we are perfectly free to pitch in and lend a hand, rendering our services in order to facilitate and assist in whatever activity is being carried out . . . epidemic, fire, flood, earthquake or other catastrophe.

But the confusion arises concerning non-emergency participation, which may be prohibited by the regulations cited. If our work in those fields is to be curtailed or limited to some degree, the change may have an overall damaging effect upon the future of amateur radio, for it might pave the way for an eventual loss of amateur frequencies. This is a sorry prospect which demands the close scrutiny of every individual amateur and every radio club. It implies a threat to the continued existence of ham radio itself, and is therefore a matter of the

come more valuable than ever before, we ought to be doing all in our power to concentrate upon our public service participation, so as to insure against any encroachment upon our allotment of spectrum space.

But if a new interpretation forbids participation in such activities, we stand to be accused of using this valuable resource in a frivolous fashion, which might very easily lead to our losing it altogether. And make no mistake about it . . . there are forces waiting on the sidelines, ready, willing and eager to assume custody and proprietary title of our frequencies at a moment's notice!

If the FCC should determine that we may not render assistance to these types of operations under the present context of the regulations, then we ought to be propagandizing and publicizing the urgent necessity for revisions of the rules so that we may participate. But how do we accomplish this objective? How can we make it clear to the Commission that it is absolutely mandatory for the rules to be rewritten in a totally unambiguous fashion so there can be no doubt as to their spirit and intent?

Once again we come to the inevitable conclusion . . . that Amateur Radio is in desperate need of adequate public relations machinery which will guarantee security against the potential attacks upon us, from whatever quarter. Once again we must point to the perfectly obvious fact that without a broad program of public education and orientation, particularly in the Nation's Capital, wherein are located the nerve centers which can determine our future existence, we stand a perilous chance of being obliterated from the scene.

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monitored. The new Standard FM

them to use tone access so both

To draw an analogy; whether you

monitored. The new Standard FM hand unit with five channels should send a lot of engineers back to the labs and should help get hand transceivers into a lot more hands during the next year or so. Bully.

Probably the most popular booth was Spectronics where you could step up with your transceiver and check out the frequency on the counter and read the deviation. This is the outfit, I suspect, that is largely responsible for the large number of Motorola HT-220's that were all over the place.

The central exhibit area.

Sidebanders got all excited when they spied the new Japanese transceiver with 1 kHz nixie readout and 500 watts which Robyn (CB) has been importing. Watch for more on this one!

HAL Devices was showing their RTTY printer. We've been promised an article on this revolutionary development by George Perrine. It prints the TT message on a scope tube rather than paper. Damndest thing I ever saw. Watch out Teletype Corporation – watch out Kleinschmidt.

Dycomm displayed their widening line of FM gear – amplifiers, sniffer, repeater, frequency counter scaler, the works. They sure are busy for a new and relatively small company. The sniffer is great – just put it near a transistor and you find out if it is working. Also fine for tuning.

rpt magazine brought out their long awaited first issue and it was a nice effort. I am sure that we all wish them well and hope that they can break the hamfest did well for its first year, and I think most of us are watching to see it greatly expanded in 1972.

Crawford Electronics drew considerable interest with their little 2m FET preamplifier (as advertised in 73, by the way)

FM Battles

My recent visit to the Chicago area for the hamfest made me all too aware of the depth of the conflicts that are growing over repeater channels, simplex operations, and other phases of FM which bring out the contentiousness in those inclined to be contentious.

One chap was absolutely furious with me for not immediately guaranteeing him that I would write a blistering editorial demanding that all those damned repeaters be taken off 94 – and taken off 94 right away! 94 is for simplex, dammit, and repeaters have no business on the frequency.

Now whether 94 should be for simplex or not is a moot point. I am sure that we can muster a goodly number of good, solid reasons why it should be and why it should not. I suspect that we can get together an even larger number of rationalizations for either side. But how many FM'ers are going to be convinced by all this bickering?

I am reminded of the old homily:

"A man convinced against his will
Is of the same opinion still."

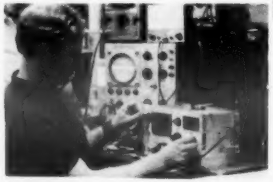
May I make an observation which will irritate all concerned? Getting mad about anything is the least productive them to use tone access so both repeaters won't work at once? Work it out instead of making things miserable for everyone. Good grief!

73 Visits National Radio

National appears to have reorganized successfully after their bankruptcy last year and is swinging along with their NCX-1000 solid state transceiver. They've cut back on employees and management, keeping the older hard-core National people who helped make the name so famous.

While most of the ham gear is now being made at the new National factory in Maine, they are still making their well-known parts – and servicing – at the old plant in Melrose, just outside of Boston.

The new National 600 receiver is the apple of their eye, though it is obviously too expensive for the amateur. Apparently National has pulled quite a coup withthis new receiver, and is having more trouble keeping up with the orders than anything else. If you need a $3000 receiver, you might look it over.



Dan Morgan K1CSJ aligning an NCX-1000.

Although National receivers were far beyond my wildest dreams during the early days of my ham career, I did climb aboard as a happy National user in the late 40's with an RAO general coverage receiver from surplus and then invested in an old National 600 transmitter, a relic of the 30's. The power supplies and modulator are still in my shack today, now powering a kilowatt two-meter rig. Not bad, over 30 years later, eh? They certainly do build things to last.

Keep up the good work, National.

Washington Lobby

A note from WA4AEZ enclosed a clipping from *Astronautics and Aeronautics Magazine* for March, which mentioned that the AMA maintains its tax-free status while it has twelve full-time lobbyists in Washington. How about it, ARRL, if the AMA can do it, why not you? Maybe just one? We sure could use the help!

The AMA spends $1,500,000 a year on political action, which comes to about $7.50 per each of their 200,000 members. It seems to be well worth the money. Perhaps, if ARRL started offering us some lobby protection, they too would have 200,000 members.

PROSECUTORS
WILL BE VIOLATED

This sign is available printed in solid black letters on yellow heavy card stock. 50¢ postpaid if the idea strikes you right. Send the half buck to *73 Magazine*, Peterborough NH 03458. Considering the cost of postage, big envelopes, and handling orders, we will not get rich on this.

self, and is therefore a matter of the gravest importance.

Since the very being of amateur radio is predicated upon the fact that it is in the public interest, any interpretation holding that the very activities which promote the service aspects of the hobby are illegal can literally sound the death knell for all of us. If amateur radio is not able to point to its accomplishments in the fields of traffic, medical communications of a non-emergency nature, coordination of public events communications, participation in service nets, etc., then it might become very simple indeed for others to convince an International Allocations Conference that our amateur spectrum might well be reassigned to a "more essential" use. At a point in history when there is a shortage of frequencies and there are more potential assignees than spectrum space to satisfy the demand, it is particularly essential that ham radio should avoid being classified as a superfluous, hobby-type activity whose public service aspects are miniscule or negligible. In fact, it should be just the opposite. At a time like this, when our frequencies have become

To draw an analogy; whether you are in favor of firearms or against them, you will have to acknowledge that the only force which has prevented wholesale imposition of anti-gun legislation has been the National Rifle Association, sometimes referred to as the "gun lobby." Every legislator, when discussing the reasons for the defeat of his particular anti-gun bill, has blamed it upon the NRA, which has maintained a strong public relations branch for this very purpose. Each time someone has offered such a bill, every senator and congressman has been deluged, inundated and drowned in a flood of letters, phone calls and wires from the constituency, alerted by the NRA, and these thousands of communications have left absolutely no doubt as to what would happen at the polls in the next election if he were foolhardy enough to vote in favor of the measure. Now, pro or con firearms, you must grant that this has proven to be an effective means of dealing with the situation. To all of which I ask, simply, "Is that bad?" Do we not regard our own activity, ham radio, with as much

(continued on News Page 6)

NOVICE
NOVICE 3725 BAND

Does the DX Decade Club seem impossible with your 75 watts and 40 meter dipole? Are you as firmly convinced as I am that there are absolutely no Novices on the air from Vermont – or Wyoming – or Delaware? Does the thought of working all zones – including impossible zone 23 – strike you as a nice goal but too impossible to really slave over? Well, 73 Magazine is issuing a series of awards for real hams – not the storybook ham with the big beam KW.

Among 73's awards is the WAZP – Worked All Zones Promised – for swearing that you would like to work all 40 zones. There is also an award which you will not find in the shack of any of the real big guns in ham radio. This is the CHC – Certificate Haters Club. You have to swear that you have never received a ham operating award and that, if you should ever receive one in the future, you will hate it with an active and all-encompassing hatred.

More seriously there are three 73 awards which actually recognize operating achievements – of sorts. One is the Worked Almost All States (WAAS) Award for working any 49 states. Similarly, there is a real endurance award which is surprisingly popular – the *Real* Rag Chewers Certificate (*R*RCC) for a six hour long, continuous, two-way QSO. Over five hundred of these awards have already been issued. It is 73's contribution to airwave pollution.

The DX Decade Club (DXDC) was started as a spoof of fanatic DXers with big beams and lots of power. For them, working 10 countries might just be an afternoon's diversion. However, the award has come to be a real operating achievement for QRPers, Novices, apartment dwellers and The certificates are quite impressive, and if we can find the stickers we have sticker endorsements for CW, 15 meters, and SSB. To apply for CHC or WAZP, just send a signed statement attesting to the appropriate conditions. For the *R*RCC send the calls of the stations involved, the operators' names, and the time and date (*both* in GMT) of the beginning and end of the QSO. For the DXDC and WAAS, you must send the appropriate QSLs. Package them carefully and please include return postage so we can return them to you by first class mail. All the awards cost a buck (of course) and you can apply to the Novice Editor, 73 Magazine, Peterborough, N.H. 03458.

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Like many hams, I got into the hobby after an apprenticeship as an SWL. The thrill of hearing Radio Japan, BBC, and HCJB has palled, but when the ham band QRM – and particularly the Novice band QRM – gets too heavy, I still do some SWLing. Like radio itself, there are as many challenges in SWLing as you care to make. Maybe Radio Peking is further away than Radio Progresso in Honduras, but to catch Radio Progresso you have to dig pretty deeply into the noise on 4920 kHz. Honduras thus becomes a great catch and Peking remains garden variety SWLing. Similarly Trans World Radio in Bonaire, Netherlands Antilles is an easy catch for almost any SWL. But the clandestine Radio Euzkadi is more of a catch – although probably broadcasting from the same general area. Its exact location is a dark secret. Broadcasting with 80 kW on 13.250 and 15.080 kHz, Radio Euzkadi is "The Voice of the Basque Underground." An excerpt from their QSL might give an indication why their programming might be more interesting than the ordinary propaganda broadcast:

"Basques were a free nation throughout history. Franco's uprising in 1936, assisted by Hitler and Mussolini, crushed the Basques depriving (4750 to 5060 kHz) will probably prove to be the best all-round tropical DX band – and the easiest. There are plenty of South American stations, and quite a few Caribbean, Oceania, and African stations.

A tougher DX hunting ground is 90 meters (3200 to 3400 kHz) which feature really low power provincial broadcasting. For the most part if you log anything on 90 meters, you will really be hearing what the people actually living in the country are hearing. The news will often be radically different from the news carried by the international broadcasting station located in the same nation's capital. There are a few truly rare DX catches which can only be found on 90 meters – including Malawi and Bougainville.

Perhaps the most challenging of all is the 120 meter band 2300 to 2500 kHz. Anyone familiar with the challenge of chasing DX on the 160 meter ham band will recognize the difficulty of listening to Latin America on 120.

On all these tropical bands the keys to success are a good antenna and knowing when to listen. You have an idea when the bands will be in good shape by interpolating from the openings on the ham 40, 80, and 160 meter bands. Similarly, the tropical bands are almost useless during the day, but night owl and early morning DXers should have a heyday. Remember, all darkness transmission paths are necessary for any long haul reception. With the current downward spiral in the sunspot cycle and the end of summer, conditions are improving for tropical band DXing. Give it a chance the next time your DX-60 is down waiting for a new final.

. . .WA1KWJ■

NEW BOOKS

Motorola has come out with a new edition of their *Semiconductor Cross-Reference Guide and Catalog*. Over 31,000 semiconductor devices are cross referenced to HEP replacements. The listing included 1N, 2N, 3N, JEDEC, and many special and Japanese type semiconductors. The catalog includes over 470 HEP products including kits, books, accessories, and the actual semiconductors. There are pages of base diagrams and min/max ratings and operating paramaters for the HEP products along with useful information on semiconductor experimenting and parts replacement in general. This really handy book is available free from your nearest HEP distributor. *MOTOROLA Semiconductors, Box 2953, Phoenix AZ 85036.*

New Literature

Cornell Electronics in San Diego puts out an interesting little catalog of miscellaneous devices including a wide selection of bargain 36¢ tubes, tools, gadgets, TV accessories, books, test meters, and audio parts. For the experimenter there are a few bargain component assortments of diodes, transistors and computer boards. The catalog has an interesting format with pages that you just tear out and send in as an order form. This makes ordering easier with less copying of catalog numbers and parts descriptions. A new catalog is sent, of course, upon receipt of an order. *Cornell Electronics Co., 4215 South University Avenue, San Diego CA 92105.*

GC Electronics Audiotex Catalog

A new catalog containing all new entries in GC Electronics' greatly expanded Audiotex product line has been issued. The exhaustively illustrated 52-page, two-color catalog includes items for use in all phases of home electronics, hi-fi, TV, stereo, audio recording, intercoms, and experimentation.

Included in the booklet are a variety of antenna installation hardware items and an enlarged cable-connector-adaptor line for stereo equipment and other audio applications. The cable line includes connectors for virtually every piece of audio equipment made in the free world.

In all, the catalog (#FR-71-A) lists more than 350 items for the music listener and hobbyist including some 150 entirely new entries in the Audiotex line. *GC Electronics Div. of Hydrometals, Inc., 400 South Wyman St., Rockford IL 61101.*

New Indexing System by Switchcraft

Switchcraft has introduced a new indexing system in their 1971 Short Form Catalog. To index the collection of over 4000 switches, connectors, jacks, plugs, and cable assemblies, every page edge of the catalog has a vertical scale of numbers running to 125. Given any component serial number, one simply looks up the serial number in the index. Next to the serial number will be a page, column, and vertical placement number. One turns to the proper page, looks at the appropriate right or left hand column and finds the particular component listing next to the vertical scale number. While it sounds a bit complex, it all takes less than 10 seconds to find the detailed catalog listing of *any* component. One doesn't have to know the type of component, nor does one have to scan long lists of similar components searching for a particular specific serial number. The vertical scale puts you right next to whatever component you want. Perhaps if other manufacturers would follow this lead, the endless catalog searching accompanying the call or pilgrimage to the parts supplier might be minimized. *Switchcraft, Inc., 5555 North Elston Ave., Chicago IL 60630.*

HOT GEAR

should be on your gear somewhere. Then if you are contemplating buying a piece of used gear, it should be a simple matter to compare its number with our list.

So send your stolen equipment numbers to **HOT GEAR** 73 Magazine,

them of the remnants of their ancient freedom. Now under Spanish rule,

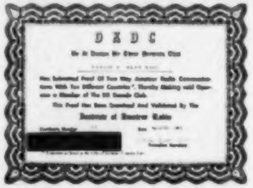
If your gear is stolen from your mobile or even from your home there

Peterborough NH 03458.

And for a starter, a Hallicrafters

73 Schussers

Novices, apartment dwellers and lini, crushed the Basques depriving | GEAR | numbers to **HOT GEAR** 73 Magazine, | *North Elston Ave., Chicago IL 60630.*



[redacted]

A vintage DXDC certificate made out to Larson Rapp, WIOU.

others who can't just pull out all the stops and go DXing. Particularly for the Novice, it can take months of 15 meter operating to earn the DXDC – not to mention tracking down the QSLs. After the hunt, though, it is a valid recognition of an operating achievement.

them of the remnants of their ancient freedom. Now under Spanish rule, without elementary human rights, Basques fight under cover to restore democracy in their land."

After a few years of SWLing with a mediocre antenna, finally using my 137' ham dipole and antenna tuner made a world of difference. I could hear so much more – even on the regular 6, 9, 11 and 15 MHz international broadcast bands. Rare or not, I still enjoy the different music, the insight into the other countries, and the wholly different news broadcasts.

And there is one more aspect of SWLing which might entice the new amateur. Throughout the tropical regions of the world, domestic broadcasting is not done on our usual broadcast bands of 540 to 1600 kHz. Instead, the so-called "tropical bands" are used. The 60 meter tropical band

If your gear is stolen from your mobile or even from your home there is little that you can do except call the police, insurance company, and maybe get a mention in *Strays*. And while buying used equipment, there is little you can do to make sure that the rig you're buying wasn't stolen. We have been aware of this situation but is wasn't until we had a 2 meter FM rig stolen that we gave any serious thought to the situation. We intend to publish a list of stolen gear every month. If you rig is stolen we'll publish the model and serial number (or any distinguishing marks) for one whole year – free. We hope that this will help reputable used equipment dealers find stolen gear along with helping you in your private deals.

This service can't help you unless you write down the serial numbers of all your gear NOW – before it is stolen. Often your guarantee card will have this information, but if not, it

Peterborough NH 03458.

And for a starter, a Hallicrafters SR46A, six meter transceiver, serial no. 446100 was stolen from WA1EMU, L.E. Fitzroy, Box 219, Hinsdale MA 01235.

ELECTRONICS FAIR

Grice Electronics, Pensacola, Florida, is holding an electronics fair, Sept. 9–12. The first two days of the fair are directed to special industrial and government buyers and engineers. The last two days, however, are for the public, with manufacturers' displays and prizes. The event, celebrating Grice's 25th anniversary, is being promoted in all the media. Many new consumer oriented devices are expected to be exhibited. Amateurs in the area might write for more information to *Grice Electronics, 320 East Gregory St., Pensacola FL 32502.*

73 Schussers Challenge All

The crack 73 ski team, seen here on a training mission high in the New Hampshire Alps, is getting ready for a challenge from any other amateur radio team. Left to right are team leader Green, Jan of the Art Department, Lin, wife of the publisher, Taylor of the Traffic Department, Nancy (Art) and Phil Price of Circulation.

The team practices almost daily during ski season on the slopes of Onset, a local ski area, except during the week before publication when they all get down to business and stop schussing around. This is just one of the little benefits of working in a low rent district of the U.S.

SOCIAL
EVENTS
and
CONTESTS

OHIO

The Findlay RC will hold their annual hamfest on Sept. 12, 1971 at Riverside Park, Findlay, Ohio. Net meetings, flea market and commercial exhibits will be featured. Talk in on 146.94 MHz FM, 146.0 AM, 52.525 MHz FM, and 50.15 USB. For more information send an SASE to Box 587, Findlay OH 45840.

Old Time Hamfest

Old Time Hamfest, Indian Hills Radio Club, Sunday, Oct. 17, 1971, Slovenian Social Home, 20713 Recher Ave., Cleveland OH. Swap-and-shop, contests, dinner and prizes. This is an old fashioned hamfest, not a buy and sell affair, although there will be a swap shop and some commercial displays. Come for fun and education. For tuckets and further information write Gladys Zimmerman, WA8ZUK, Public Relations, Indian Hills Radio Club, 1504 Maple Grove Road, Cleveland OH 44121.

F.A.R. Hamfest

The Foundation for Amateur Radio, Inc., an organization consisting of 27 amateur radio clubs all located in the greater Washington, D.C. metropolitan area, will hold its annual hamfest on Sunday, 24 Oct. 1971 from 10 AM until 5 PM at the Gaithersburg Fairgrounds in nearby Gaithersburg MD just off Interstate 75. For more information, write M. F. Cone, WA4PBG, 317 Van Buren St., Falls Church VA 22046.

ILLINOIS

The Peoria Area ARC will hold its 14th annual Hamfest Sunday, Sept. 19, 1971, at Exposition Gardens (same place as last year), located on the northwest edge of Peoria IL. Lunch will be available. There will be plenty of activities for the entire family, beginning with the campsite opening the preceding evening. Free coffee and donuts from 9:00 to 9:30 AM CDT. Free swap section, parking, contests, and cartoons for the kids. Advance registration $1.50, at the gate $2.00. For further details and advance registration write Wendell McWilliams, WN9DZJ, Box 1, Rome IL 61562.

Fifth District QSO Party

The first annual QSO Party sponsored by 5th District Chapter 26, CHC, will feature certificates to high scorer in each state, province or country, and a trophy to highest score in the contest and to highest score in the 5th District. The same station may be worked on each band and mode, and mobiles may be worked again in different counties.

Contest runs from 0000 GMT, Sat., Oct. 9, 1971 until 0000 GMT, Mon., Oct. 11, 1971.

Exchange usual RST and QSO number plus state, county and country. Suggested frequencies are 3575, 3940, 7060, 7150, 7260, 14075, 14343, 21090, 21100, 21360, 28600, ssb 50.1–50.2, am 50.2–50.5, 145–147. Mail scores by Nov. 1 to Pat Pattee, W5POH, Mountain Home Ark. 72653.

Illinois QSO Party

The Radio Amateur Megacycle Society, K9CJU, will be sponsoring the ninth annual Illinois QSO Party from 1600 GMT, Nov. 6, 1971 until 2200 GMT, Nov. 7, 1971. All bands and all modes are to be used. Basically, out-of-state hams work Illinois counties. For details, awards, and suggested frequencies, send a SASE to K9CJU, 3620 N. Oleander Ave., Chicago IL 60634.

TELCO CONTEST

This year the Indian Hill ARC at Bell Labs Indian Hill facility, Naperville IL, will host the 12th annual "CQ-Western Electric" contest for all licensed amateur radio operators employed by or retired from Bell Laboratories, Western Electric, AT&T, and Teletype and Sandia Corporations. The objective of this world-wide contest is for each participant to contact as many other participants as possible via ham radio.

The contest will be held on the first three weekends in October with each weekend devoted to a different mode of amateur radio operation. The first weekend will be CW (with special Novice competition), the second weekend, phone, and the final weekend will have a period for RTTY and VHF operation.

Awards to to the individual with the highest contest score and top scores in various categories of operation, and to the retiree with the highest score. There is also a traveling trophy which is sent to the company location with the highest score.

The contest rules have been formulated to encourage the participation of retirees. There will be bonus points for retiree contacts.

Anyone can obtain a complete set of the contest rules by contacting the amateur radio club at his base location or Indian Hill Amateur Radio Club, Bell Telephone Laboratories, Naperville IL 60540.

DX FOOTNOTES

While both Chinas have been in the news recently, there has also been some noteworthy DX activity from both Red China and Taiwan. While nobody is positive whether BY1AB and BY1AA are genuine, beam headings from both Japan and the West Coast indicate that the stations do seem to be in Red China. BV2A continues to appear on 20 CW and a group of Japanese hams are plowing through the red tape aiming at a BV expedition for a future DX contest.

A few more weird prefixes for those who have been following this column: WL2NAS, at the 50th anniversary Lighter-Than-Air Celebration in Lakehurst, N.J., KC2GMF, Greater Monmouth County Fair; KF4SJ, commemorating the 450th anniversary of San Juan, Puerto Rico (QSL to Box 1871, Ponce, Puerto Rico 00721); and WS0ATA, Bellevue,, Nebraska RC. From Japan we're hearing the JE1 and the JR1 prefixes. And just a few years ago you thought that WB2 sounded funny.

Peruvian stations can use a special OB prefix for the remainder of this year. There is a special award for working 15 OBs.

While 73 is running our survey to find out the most wanted Caribbean DX for the *Reverie* DXpedition, the DARC polled German DXers for their worldwide most wanted list. The rarest countries are Clipperton (the rarest of them all), Minerva Reef, Bouvet, British Phoenix, Maria Theresa, China, Willis, Tonga, Tokelaus, and Revilla Gigedo. Plan your DXpeditions accordingly!

C21AA has been found operating on 14185 kHz and listening on 14200 kHz. This is just an example of why a good search through the entire band can often produce more DX than a cursory listen from 14200 up and

time can receive a helping hand in working Tom. This is, of course, a lot easier way to work VR6TC than battling the hoards calling Tom after the schedule. A SASE is a necessity in getting a Pitcairn card, and contributions are sought to keep VR6TC's gear in operating condition.

Another helping hand for would be big guns – the Micronesia Net often attracts some good DX. Although basically a traffic net, courteous operating should result in a boost in your countries total. The net meets Tuesdays, Thursdays, and Saturdays at 0800 GMT on 14335 kHz.

From the DX Footnotes mailbag . . .

I suggest you scan the letters column for the letters concerning operation from Turkey. It seems that with the declaration of martial law in that country, ham operation was ended although it had previously been tacitly permitted but officially prohibited. Ham gear has been confiscated, hams have been jailed and fined, and many hams have gone underground. It's not a good time to be a TA.

Tom Karlsson, SM1CNS and SM6CNS/MM, has asked for others' opinions on moving W1AW's code practice out of the low ends of 40 and 20. Tom maintains that the code practice frequencies interfere with foreign DXers and suggests that a change of W1AW frequencies to 7050 and 14080 kHz would be most helpful. Tom has already written to the League about the problems of foreign DXers . . . but without a reply. As one can see from the picture, Tom has quite a neat little shack.

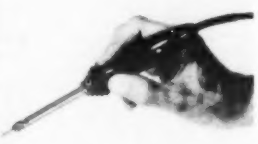
K7GHZ wrote to say that his friend EP2DM (Jauad) will be on the

NEW PRODUCTS

Mobile Battery Aid

The Terado Corp. of St. Paul, Minn. has announced the production of a new R-V-CHARG unit. The R-V-CHARG model #50-125 is a compact solid-state controlled unit which allows the amateur radio operator to operate his mobile equipment from a separate battery while parked with the automobile. It automatically disconnects the main starting battery in the vehicle when the engine is off. This R-V-CHARG equipment has the advantage of keeping both batteries charged while the vehicle is running.

R-V-CHARG is installed under the hood of the car without any holes through the firewall. It takes a few simple connections to the electrical system and is ready to handle 150 A. The unit is solid state controlled and compact. It lists for $13.95. *Terado Corp., 1068 Raymond Avenue, St. Paul MN 55108.*



Controlled Temp Soldering Iron

Telvac Instrument Co. has introduced a soldering iron with controllable temperature from 400° to 750° F. Called the Oryx Model 50, this iron has a built in thermostat to keep the iron's temperature constant at the desired heat. The 50 watt element features fast initial heating and near instantaneous recovery from heavy joint loads (e.g. lugs and heavy terminals). A wide variety of tip shapes, sizes, and materials are offered along

Solid-State Dipper

The Millen Co. has announced a new solid-state dipper to replace their familiar tube grid dipmeter. Powered by a 9 volt battery, the new dipper (number 90652) is said to equal the performance of the tube grid dipper but to include all the advantage of portability and a built in power source. Covering the range from 1.7 to 300 MHz with 7 plug-in coils, the dipper can be used to monitor modulation, check resonant frequencies of non-energized resonant circuits, and can be changed by simply plugging in a TN-91 of the frequency desired. Each Silent tone contains two sections, the encoder network (ST-85H), and the tone determining network (TN-91H), and features small size, 1-1/8" x 1-1/4" x 5/8", built in voltage regulation and one year 100% warranty. *Alpha Electronic Services, Inc., 8431 Monroe Ave., Stanton CA 90680.*

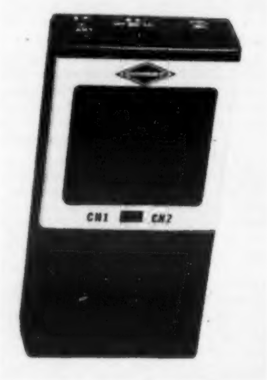
Do It Yourself Custom Resistors

Digital Instruments Corp. introduced their new resistance kit called FLEXTRIM. This wire kit is intended for use in making any value resistor, shunt or multiplier in connection with repair, production and experimental electronic work immediately. Both Manganin and Karma wire are used because of their low temperature coefficient of resistance and neither changes their value with age or temperature which is encountered in normal use. Resistors cost approximately .02¢ each.

Kit 101 contains fine wire alloys whose availability prior to this was

tivate the receiver. The Silent tone encoder (ST-85H) can be used where the repeater only is to be quieted. The new transistorized circuitry and the elimination of mechanical reeds and relays makes this thoroughly field tested unit stable and reliable.

Tone frequencies are available in a wide choice (20.0 to 203.5 Hz) and act as an absorption type wavemeter. This straightforward and rugged meter sells for $110. *James Millen Mfg. Co., Malden MA 02148.*



Gonset VHF Portable Receiver

GONSET announced its new model 6 RP VHF high-band, personal portable receiver. The GONSET model 6RP is a high-performance, FM narrow-band "pocket" type receiver, with built-in antenna for monitoring over the range of 146 to 160 MHz. The 6RP may be powered with replaceable mercury cells, or rechargeable nickel cadmium batteries. Other options include two-frequency capability. The 6RP also features signal-to-noise ratio squelch, which is adjustable from the outside of the unit. *Aerotron, Inc., P.O. Box 6527, Raleigh NC 27608.*

can often produce more DX than a cursory listen from 14200 up and then a CQ DX.

For those who no longer think of I, UA, G, or DL as DX, just try to snag I7ZCZ. He's been working into the U.S. using only 2 watts. Also running QRP is UA2CR. He's aboard an ice-breaker in the Barents Sea and he runs 3 watts of SSB.

There still is a lot of DX to be snagged through the DX nets. Some of the rarest Middle Eastern DX stations form the Middle East DXing Society which is offering the Arabian Knights certificate for working 10 Arab countries (must include JY1) after January 1, 1971. Seven IRCs and a verified QSO list to JY1 are required for the award. To work the 10, try getting on a list formed on Thursdays at 1900 GMT on 14295 MHz. The DX should then appear on Saturdays at 1800 GMT on 14295 kHz.

I don't know if it is having read *Mutiny on the Bounty* too many times as a kid or whether it was umpteen *National Geographic* articles on Pitcairn Island, but somehow working Tom Christian, VR6TC, on Pitcairn Island seems like extraordinarily enticing DX. Luckily, lower power stations stand a chance to work Tom by contacting his QSL manager, W5OLG (Bob), *BEFORE* 2045 GMT Tuesdays on 21352 kHz. This is the time for Bob's weekly sked with Tom. Those who hook Bob before schedule

DX'ER CLOSEUP. . .

WA2RAU, Doc, who engineered the shipment of tons of medicines to the Congo and who can be heard almost daily just about anywhere in the world on 20 meters.

K7GHZ wrote to say that his friend EP2DM (Jauad) will be on the air from Iran until October before his return to teach at Florida State University. QSL via K7GHZ, 3213 "R" St., Vancouver, Wash. 98663.

The following is exerpted from a South African Radio League notice:

A DXpedition will be held during the 9th and 10th of October, 1971, when Jack ZS3KC and Smitty ZS3XQ will take a trip to the well known Cape Cross, where Diego Cao planted his cross in 1482 after his long sea journey to establish the South point of Africa. The call ZS3CCE will be used for this expedition. The time of operating will be from 2200 GMT 8th till 2200 GMT 10th October, 1971, non stop. CW and SSB to be used on the following frequenies:

SSB: 7.070, 14.200, 21.280, and 28.600 MHz.

CW: 7.020, 14.050, 21.050, and 28.050 MHz.

In case of occupation of the mentioned frequencies, transmission will take place within ten kHz on either side. It would be appreciated if the above mentioned frequencies could be kept unoccupied during that weekend.

QSL cards will be sent out via the bureau for every successful contact. The duration of all contacts should be limited. (No rag chewing).

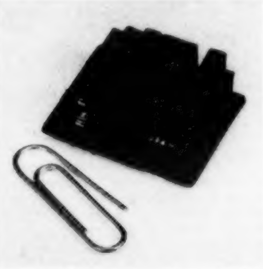
The Virgin Islands Transmitting and Listening Society (VITALS) wrote in to announce a mini-DXpedition during the period October 9–17. Along with maritime mobile operation, the operators hope to work from PJ8, FS7, and VP2. Look for them on 20, 15, and 10 meter CW and SSB. QSL with a SASE via air mail to Command Communications, Box 3374, St. Thomas, Virgin Islands

So, please let me know if this different type of DX column is helping any of you snag a few more countries. I hope it will be more interesting and more helpful than a long list of who worked whom. Don't forget the free subscription to 73 for each usable DX photo. WA1KWJ■

als). A wide variety of tip shapes, sizes, and materials are offered along with an optional safety stand and two or three wire line cord. *Telvac Instrument Co., 14614 Raymer St., Van Nuys CA 91405.*

Miniature IC Sub-Audible Tone

Offered as the first all integrated circuit sub-audible tone encoder/decoder, Alpha Electronic Services Inc. announced its new SS-80J. Measuring less than one square inch including the new TN-91J frequency determining IC module, the SS-80J is the smallest non-reed CTCSS device available.



The unit was designed especially to offer high reliability by the elimination of mechanical and contactless reeds and still be small enough to be installed in hand-held transceivers and pocket pager receivers.

Under development for two years, the SS-80J has been subjected to a rigorous testing program to establish long-term reliability. Claiming excellent stability, the unit meets or exceeds all applicable EIA specifications and is available in standard or special frequencies from 20 Hz to 250 Hz.

Special configurations are available for easy mounting in most hand-held and portable units along with instruction manuals that clearly outline step-by-step installation. *Alpha Electronic Services Inc., 8431 Monroe Ave., Stanton CA 90680.*

Kit 101 contains fine wire alloys whose availability prior to this was only in bulk and at a price not economical for the average experimenter, technician, engineer, amateur, etc.

Kit 101 contains 7 resistance wires ranging from 0.5–300Ω per foot (5000Ω per foot optional), 11 epoxy glass bobbins, instructions, simple schematics, all neatly arranged and identified. The complete kit is housed in an acrylic plastic container.

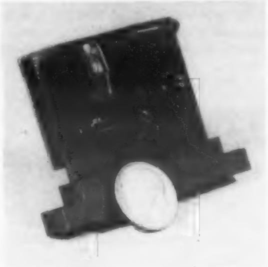
The wires used boast of low noise, high thermal stability, polyurethane enamel insulation, average tensile strength of 180,000 PSI, and being non-magnetic.

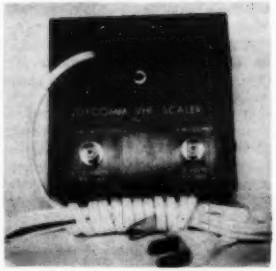
Typical applications include instrument calibration and repair, Wheatstone bridge construction, audio and hi-fi circuits, and modification of current and volt meters.

The kit costs $12.95 from *Digital Instruments, Inc., 19025 Parthenia / Northridge CA 91324.*

Continuous Tone Encoder

Alpha has announced a miniature all solid state continuous Silent tone encoder designed for use in all two-way radio communications systems and equipment. They say it is compact, easily installed, and provides an end to interfering signals and the necessity of listening to co-channel users by requiring that transmissions to repeaters be accompanied by a predetermined sub-audible tone to ac-





Low Cost VHF Pre-Scaler

Dynamic Communications has introduced a new divide-by-ten frequency pre-scaler/divider designed the PSU-13. It operates over a frequency range of 10 MHz to greater than 240 MHz. Circuitry features high input sensitivity (less than 100 mV) and high output voltage (greater than 2V p-p). The unit can be used to expand the frequency range of counters and oscilloscope synchronization. Proper operation is automatic, and the price is an incredible $89.95. *Dynamic Communications, P.O. Box 10116, Riviera Beach FL 33404.*

UHF Amplifiers

TRW Semiconductor Division has introduced a series of microelectronics, broadband, UHF amplifiers to work in wide segments of the 403 to 512 MHz range. Different units in this series of tiny amplifiers have power outputs of .75 to 7.5W, power gains of 16 to 20 dB, and power inputs between 2 and 50 mW. All units boast efficiencies above 40%, wide temperature range, and standard 50Ω input and output impedances. The largest of the units – with 7.5 watts out on 5.2 MHz – has a volume of .6 cubic inch. The smallest is only about .33 cubic inch. *TRW Semiconductor Div., 14520 Aviation Blvd., Lawndale CA 90260.*

(Continued on News Page 5)

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I insist that you print ev

LETTERS

MARS

I'm an X-ray Technician in the U.S. Army stationed at the 97th General Hospital in Frankfurt, Germany. I enjoy reading your magazine very much.

As soon as I get my license, I plan to use my equipment to transmit calls from members of the Armed Forces here in Europe to relatives back in the States in an attempt to relieve a part of the load that's on the MARS system here. There are only 3 stations in Frankfurt to serve some 50,000 servicemen and women. One more station will certainly help. The typical MARS station operates 24 hours a day, 7 days a week.

The ham operators in the States are doing an *outstanding* job completing the calls. The people here who have used these services hold a high regard and admiration for the ham operator.

I think an in-depth article on MARS radio and the ham would be interesting and informative to the public, as well as helping the amateur image. It might even sell a few more magazines, too!

Our thanks go to the amateur operators of the U.S.

Box 44
97 B Gen. Hosp.
APO N.Y. 09751

And our thanks to you! We are sorry that our letter-opening machine chopped off your signature so that we are unable to include it.

You mentioned you would like to know our views on amateur radio and the value of MARS. Well, amateur radio is one of the greatest hobbies I have run across yet. As soon as I get home my wife and I are seriously considering trying to get our own rig.

Running MARS is by far the best

and all that stuff . . . only on a sailboat (60 feet). It will start from Italy and come to Turkey via Greece, and come to the Aegean coast of Turkey and stop at the main tourist spots, such as Ephesus and Troy and Pergamum, all of which are in almost the same state as Pompeii. We would continue to Istanbul and spend 2–3 days and return to Italy, stopping at Izmir (ancient Smyrna) only. There would be no charges other than the $20 per day per person, including food and whatever else is required to live on a ship for 15 to 18 days. Land transport and tourist guide service also included. I would like to get opinions on this matter as to its feasibility where Americans are concerned. I plan to have the rig HW 100, and an extra receiver and transmitter and Teletype equipment on board. I thought it might be a little something extra for a person to be able to operate from the Mediterranean and Aegean. My purpose is to make money and enjoy a pleasant job at the same time, but I am also a history nut and I would like to acquaint people with the tremendous amount of historical riches in the country here. Most of it is on the coast, so a boat is a natural way to get there.

James Binder
SITE 137
APO N.Y. 09254

. . . and Answer

In a letter from one of the Turkish hams, the following data comes to light:

The following hams in Turkey have been arrested and have been put in Turkish prisons: TA1NC, TA1OR, TA3WW, TA3AY, TA3OZ, TA6VY . . . and others unknown to the Istanbul ARC.

(somewhere) the index you published for 1960–66, but it *is* kind of a pain in the neck to have to locate an article published in the last 4 years. Do you have any plans to publish an updated index?

Scott Marovich
530 West Barry St., Apt. 3C
Chicago IL 60657

After taking a good look at what has happened to the parcel post rates we upped the price of those binders to $5 so you made a smart move. It sure would be nice to have a good, thorough eleven year index, wouldn't it? If I have a few days with nothing whatever to do I may sit down and work one up. Say, perhaps a reader who has a complete collection of 73 would be interested in a project like that? Fame and fortune (ha!) await.

. . . Wayne

BACK ISSUES

I am now almost 71 years of age and not in the best of health. I have a complete file of 73 all in as-new condition. Would like to sell, or would consider 144 MHz FM gear. Interested?

Cliff McCullough (W4HSV)
326 Malaluka Road
North Port Charlotte FL 33595

Anybody interested?

15 Meters

I wish to pose the following question. Why is 15 meters so dead at night? Naturally I am not talking about DX but I am talking about local ground wave contacts. This band would give many a Novice a real surprise and pleasure if they would make a concerted effort to use the nighttime potential of 15 meters for a local chitchat band. Forty is so loused up at night, but 15 is a lonely wasteland just begging to be discovered. A goodly part of ham radio is meeting people where you find them, and it is no mortal sin to QSO a guy ten or twenty miles up the road on 15 without the QRM of nighttime forty.

Allan S. Joffe W3KBM
531 East Durham St.
Philadelphia PA 19119

Perhaps everyone is now down on 2m FM?

(Continued from News Page 4)

Plug-in Repeater Tone Panel

Alpha Electronics has introduced a ten tone repeater control panel. Normally taking up to ten plug-in modules in the range of 20 to 203.5 Hz, the panel can be expanded to take up to forty different tones with an accessory panel. The board uses no reeds or relays for increased reliability. Normally powered by 12.6V dc, an optional 117V ac supply is available. The panel has built-in voltage regulation. *Alpha Electronics Services, 8431 Monroe Ave., Stanton CA 90680.*

OMISSIONS IN JULY

In the "New Literature" section of July's News Pages, we inadvertently left out the addresses of Signetics and GC. For Signetics' "Applications Memos," write to *SIGNETICS, 811 East Arques Avenue, Sunnyvale CA 94086*; for GC's General Catalog, address *GC ELECTRONICS, Div. of Hydrometals, Inc., 400 South Wyman Street, Rockford IL 61101.*

Good Project

In the May 73 Magazine, page 58, the article "Advanced Preamp-Compressor Clipper" appears like a very good project to build. Since the author has made quite a study of the subject I think it worthwhile to follow his efforts closely. Rather than guess,

REPEATER UPDATE

The Dalles, Oregon repeater was listed incorrectly. Located on Lookout Mt., it operates on 52.92/53.46. The call is W7FIO. A two meter repeater is being constructed by the same group, The Dalles ARC. It will operate on 146.34/146.94.

There is a new RACES related repeater in Valhalla, N.Y. Running 220W output at 750', K2AVP operates narrowband on 146.46/147.06. During the weekly RACES drill the alternative input frequency of 145.68 is used. It is an open repeater and covers southeastern N.Y., southwestern Conn., and northern N.J.

W9BYZ/9 in northern Illinois has added an additional input frequency to its listed 146.34/146.76. The repeater now operates on 146.16/146.76 also. A 1650 Hz tone burst is used.

An experimental ten meter FM repeater is operating in Ft. Walton Beach, Florida under the call WB4EQU. It uses a half second 1800 Hz tone for activation and normally works on 29.44/29.60. When simplex activity on 29.60 demands it, the output can be changed to 29.64. The machine is tape logged and users are asked to begin their first transmission with the time in GMT. The repeater is an experiment to test the feasbility of ten meter FM repeaters.

The repeater in Muncie, Indiana is K9SJI on 146.34/146.76. It is whistle on (1700 Hz) or can be activated with Touchtone 18. It has a coverage of about a 25 mile radius.

The Dayton, Ohio repeater, WB8CQK, operates without a tone on

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job I have held in the Service. It really

In July, 1970, Selim, TA2SC, was

Thanks

Regarding an article in the April

would you please let me know the component values in question?

146.28/146.76 for the use of base stations. It also operates on job I have held in the Service. It really does something good inside of the OPS and for the people who use the system. Most of our thanks go to the hams and MARS stations in the States who give up their time to come up on the air and run patches for us.

Dick, Joel, Don & Gary
ARMY MARS STATION (AB9USA)
Korat, Thailand
AUG A, 442D SIG BN (LL)
APO S.F. 96233

Turkish Hams = Question

I am writing to ask about something in the March 1971 issue concerning a forbidden list of countries by ITU order. My call is WB2YFO and I applied to TRAC (Turkish Amateur Radio Club) for permission to operate when I got here, and they gave me TA6JB. I also have the membership booklet and ID card and all that. Operation is not strictly legal I think, since the law technically has never been changed to allow it, but I assumed there was some sort of unwritten agreement to allow operation if one joined the club, or so I was told. Now I see in the list I mentioned that TA calls are evidently considered outlaws, so I ceased operation so as not to get anyone in trouble that might contact me (about 300 every month until now), and I decided to write and find out the true story from you. I know the law is to be changed according to the government announcements. Everyone, including the government, knows of the club and the amateurs, since they were in the paper – pictures and all – and I can't understand how such a wide open operation can be completely illegal. They also print a monthly magazine which is sold on the newsstands in plain view. That is how I found out about it.

I am planning to have a sailboat that can carry 10 persons and crew for charter. I was planning to have my rig on there, either with my stateside license if possible, or another country like England or Italy, if I get a residence permit there. I would like to attract amateurs who would like to go for a cruise which will actually be like a bus or airline tour with guide, food, In July, 1970, Selim, TA2SC, was arrested and his equipment confiscated. He was given a suspended sentence as he was a minor.

All this was brought about by the recent declaration of martial law in Turkey during the leftist terrorist acts.

The only way to bring about legalized amateur radio in Turkey is for the repeal of Turkish Law 3222, which forbids it.

Communications in Turkey come under the authority of The Ministery of Interior, Ankara, Turkey.

I'm not sure what can be done about their plight; however, ham radio there will be as rare as in Syria and Iraq if nothing is done.

Roland L. Guard Jr. K4EPI
750 Lily Flagg Road
Huntsville AL 35802

DISCREPANCY

There seems to be a conflicting statement of time required to assemble the Heathkit's new frequency counter – here is how I read it: Page 19 of June '73 shows the New 15 MHz Frequency Counter by Heathkit. In the list of specifics, the statement is made, "Easy five hour Assembly." Now let's look at the page 48 story, "I built a counter" where it states, "the kit had taken about 15 hours to complete . . ." What speed genius belonging to Heathkit's organization builds this kit in an easy five hours, assuming Sessions' story is accurate?

W. E. Nichols W6VVF
543-46th Avenue
San Francisco CA 94121

IN A BIND

Well, I've finally gone and done it . . . with an eleven-year collection of 73's sitting around, getting more dog-eared by the day, I figured there was just no other way. Please send me (ulp!) eleven 73 binders, with year-stickers for 1961–71, at a total cost of (gasp!) $44.00. Really, this hurts me more than it hurts you! The pain is killing me . . . I doubt if even a lifetime subscription could make it subside.

You know, once I get my collection bound, it certainly would be nice to have a new cumulative index to 73 articles through 1970. I do have

Thanks

Regarding an article in the April 1971 issue of 73 entitled "Stability without crystals," the article is incorrect in stating the MODCOM has no crystal. The MODCOM is a temperature compensated crystal oscillator and Sentry has always represented it accordingly.

We are naturally pleased at the test results conducted on the MODCOM and we sincerely appreciate 73's article since it accurately demonstrates the operational features and performance of the unit.

Michael W. Sigmon
Marketing Manager
SENTRY Manufacturing Co.
Chickasha OK 73018

FM . . .

This 2m FM is obviously an exciting mode. I certainly enjoyed the transceiver and repeater directory. I would sure have one of those new transceivers if there were any other hams in the area with similar equipment. Ken Sessions' article on FM was enlightening but how far will these typical transceivers reach out without a repeater? I fear if I had such a rig there would be no one in range to chat with. I think my subscription is almost up and would like a crack at one of those $50 life memberships you used to have on special. I've been looking but haven't seen it offered lately. Tell the advertisers to keep up the informative ads, because we can't buy it if we don't know about it.

Sunny Mitchell WA0PIN
R. 1
Dakota MN 55925

You should have no trouble getting into the Minneapolis repeaters if you put up a beam. Give it a try and join the fun. Alas, the $50 Life subscriptions have gone the way of the 5¢ hot dog. The doubling of the postal rates during the next year will force subscription prices upwards even more and – unless the government monopoly on handling mail is ended so efficient commercial companies can get prices down via the competition route – an unending spiral of postal rates looms ahead.

. . . Wayne

would you please let me know the component values in question?

Clayton G. Decker W2GXL
RD 1, Camp Road
Rexford NY 12148

Of course.
T1 – N-channel FET; T2 – NPN low-noise silicon; T3–T5 NPN general purpose silicon; D1–D3 – 100 PIV Silicon; D4, D5 – 50 PIV germanium; R3 should be selected according to gate-to-source breakdown voltage of individual N-channel FET.

K1CLL

I've subscribed since I got my ticket some four years ago and have always been impressed with the overall latitude of 73's coverage, especially Bill Hoisington's construction articles. Has he ever considered putting them out in a book?

Norman B. Blake WA1IVB
12 Oriole Rd.
Stoughton MA 02072

Yes, one in the works.

VHF Gain Antenna . . .

I enjoyed what there was of the article on gain antennas (73 - July 1971). As you probably have heard by now, you failed to include the cutting chart.

I might add that the velocity factor of the coax used is even more important than the length! Most 'poly-foam' types are 0.78 but there is a lot of the older stuff around which is 0.66. It is best to go directly to the manufacturer for this data, and more often than not the larger supply houses and ham stores will have that information sheet available.

I suggest that prospective builders DO NOT use the 'miniature' coax as its losses are considerable. Stick with RG/58U or larger.

ANY number of ODD ½ wavelengths can be used at position "C" in the article if antennas with more or less gain are desired. I have tried everything from a total length of about 6 ft to over 40 ft with the only difference being the extreme compres-

(Continued on News Page 6)

146.28/146.76 for the use of base stations. It also operates on 146.34/146.76 with a 2000 Hz tone for the use of mobile stations. The old tone frequency of 1250 Hz should be deleted from our previous listings.

WA7KZG is a new repeater near Chehalis, Wash. Using gain antennas at about 3325' for both transmit and receive, coverage for mobiles extends from Portland, Oregon to Tacoma, Wash. Frequencies used are 146.34/146.94 with a 1950 Hz tone burst. Units without a tone can often get into a conversation due to the repeater's 2-second-long squelch tail. Using stations are asked to wait 10 seconds after their last transmission and then to sign themselves and the repeater out.

W4JNB is the Muscle Shoals ARC repeater now operating in northwestern Alabama on 146.34/146.94. No tones.

We are totally redoing our Canadian listings. Some of the more recently noted changes and errors include VE7BEL which should have been listed with its QTH, Victoria, B.C.

The Edmonton, Alberta repeater, VE6WQ, should be listed as operating on 146.46/147.00. Simplex operation in the area is on 146.7 and 146.94.

The repeater listed as VE7ACS should now be VE7RPT. This repeater is up about 3500' on Mt. Seymour. It uses gain antenna on both transmit and receive and covers about 90 miles in all directions on 146.34/146.94. Coverage extends into a good part of Washington state.

VE7MQ and VE7APU were obviously misfiled as Washington repeaters. Similarly, the repeater listed as W7DXX on Rattlesnake Mt. appears to be an experimental extension of W7PUG. It operates with either a 146.34 or a 146.76 input for a 146.58 output. W7PUG itself is in Seattle and is now using 146.88/146.58.

W3OK should be on the air on 146.16/146.70 with 150W from Nazareth, Pa. with coverage of parts of Pennsylvania and New Jersey.

LEAKY LINES

(continued from News Page 2)

pride and jealousy as those who are devotees of gun sports?

Unfortunately the image of amateur radio in the public's estimation is much less complimentary than we would like to believe. So far as the man in the street is concerned, we are often regarded as a group of screwballs, playing around with kids' toys. We are lumped together with stamp collectors, spelunkers, model plane fans, kite flyers, bird watchers, amateur taxidermists, collectors of old hooch bottles and seashell fanciers. We rate hardly any notice at all. If a neighborhood urchin's kitten is rescued from a tall tree by the fire department, it will get full coverage with close-up pictures on page one of the local paper. But if a ham station is in action for 72 hours straight, assisting in some life-and-death situation like an earthquake, shipwreck, deadly epidemic or volcanic eruption, enabling a virtual miracle to occur through the amateur's dedication and passionate commitment to service, if it is reported at all, it will very likely turn up on page 37, opposite the tide tables and the lost-and-found!

Of course, if there is a story about TVI, this will definitely get front page coverage, accompanied by an eight column scare-head, reading, LOCAL HAM OPERATOR POLLUTES ALL TV CHANNELS. VIEWERS DEMAND IMMEDIATE ACTION. GOVERNOR RECEIVES PETITION. Perhaps I'm overstating the thing, but this is the sort of thing that happens, and it is being made abundantly clear that our stock is just about as low as it can get, so far as the general public is concerned. If you doubt this, just reflect upon the numbers of bills which have been introduced in local legislatures against the interests of ham radio. Just recall the numbers of local ordinances against antennas and towers. Just remind yourself of the million buck lawsuit against Grid, dung heap.

In the face of such incontrovertible evidence, how can any of us dare to feel free and easy about the future? And since our continued existence depends almost entirely upon our performance as a *service* dedicated to the public good, how are we going to preserve whatever esteem we may happen to enjoy, if the FCC takes away our right to participate in precisely those activities which enable us to fulfill the functions which are demanded of us?

Is there some means by which we can help convince the Commission that it ought not to limit our participation on these operations? Well, it is clear that if we wish to influence the FCC's thinking on the subject, we will not be able to do so if we do not open our mouths. We simply cannot afford to allow ourselves to be lulled into thinking that this will be done for us by someone who looks after things at long range, from Connecticut. The League will undoubtedly express some sentiment on the matter, but this does not necessarily mean that it will coincide with your ideas or mine. There will be a recommendation from ARRL arrived at after some joint discussions among the Directors and staff. But in my opinion the FCC ought to be notified by each individual amateur, speaking from his own individual point of view. The rules provide for this, as you know. And I hope sincerely that in this one instance, at least, every single amateur, whether a League member or not, will send in his comments in order to give FCC his side of the picture. Clubs should discuss their stake in the matter also, and should come to collective opinions which should be relayed to the Commission as well. We can't afford to allow a single stone to remain unturned, for the stakes are altogether too high.

Another task which is essential; there is not a periodical in this nation which does not need filler material for its columns. There is not a single

Caveat Emptor?

Price — $2 per 25 words for non-commercial ads; $10 per 25 words for business ventures. No display ads or agencydiscount. Include your check with order.

Deadline for ads is the 1st of the month two months prior to publication. For example: January .1st is the deadline for the March issue which will be mailed on the 10th of February.

Type copy. Phrase and punctuate exactly as you wish it to appear. No all-capital ads.

We will be the judge of suitability of ads. Our responsibility for errors extends only to printing a correct ad in a later issue.

For $1 extra we can maintain a reply box for you.

We cannot check into each advertiser, so Caveat Emptor. . .

CANADIANS, Japanese gear, LOW, LOW prices. Free catalogue and information. Glenwood Trading Co., Dept. A, 4819 Skyline Dr., North Vancouver, B.C.

SAROC Seventh Anniversary January 6–9, 1972. Advance Registration $9.00 per person entitles registrant to SAROC Special room rate $12.00 per night plus room tax, single or double occupancy, effective January 4 thru 12, 1972; tickets for admission to technical seminars, HAM RADIO MAGAZINE and SAROC Happy Hour Thursday, SWAN ELECTRONICS and SAROC Social Hour Friday, HY-GAIN/GALAXY ELECTRONICS and SAROC Champagne Party Saturday, Buffet Hunt Breakfast, Sunday. Ladies who register will receive transportation for shopping tour, luncheon and Crazy Hat program at the New Union Plaza Hotel downtown Las Vegas, Saturday. Advance Registration, with Flamingo Hotel mid-night show two drinks, $14.50. Advance Registration, with Flamingo Hotel Dinner Show (entrees Brisket of Beef or Turkey) no drinks, $17.50. Tax and Gratuity included except for room. Frontier Airlines SAROC group flight package planned from Chicago, St. Louis, Omaha, Denver, send for details. Fifth National FM Conference, ARRL, WCARS-7255, WPSS-3952, MARS, meetings and technical sessions scheduled. Accommodations request to Flamingo Hotel, Las Vegas, Nevada before 15th December. Advance Registration to SAROC, Southern Nevada ARC, Inc., Box 73, Boulder City, Nevada 89005, before 31st December.

A TRANSFORMER FOR LINEAR BUILDERS. Tapped 115 v.pri.Sec 1050 v at 1 amp. C.T.Can be used in bridge circuit for sweep tube or in a doubler circuit would furnish over 2900 volts at 500 ma. for zero bias triodes. Sealed case. $14.95 plus shipping. Wt. 47 lb. Can be shipped via U.P.S. A.R.C. Sales, 181 E. Wilson Bridge Rd., Worthington, Ohio 43085.

THE NOVICE newsletter, articles geared to Novices, DX, traffic, Novice net activities, construction projects, more. $3, year. (monthly) Sample, stamp. 1240 21st St., Hermosa Beach, Calif. 90254.

ANNUAL FINDLAY, OHIO HAMFEST will be September 12th at Riverside Park. Net Conferences, Flea Market, Swap-Shop, Door Prizes, Manufacturers' Display, MARS, Etc. Donation $1.00 in advance, $1.50 at park. Tickets and details from Dan Jernigan, K8VXD, Route 2, Findlay, OH 45840.

NEW MEXICO HAMVENTION 1971 will be presented 17, 18 and 19 Sept. 71, at Sheraton Motor Hotel, Albuquerque. Technical Sessions, Top Speakers, Ladies Program, Entertainment and Swapfest. Banquet on 18 Sept. For Info and Registration: NEW MEXICO HAMVENTION, Inc., Box 14381, Albuquerque, New Mexico 87111.

SALE: RCVR RCA CRM-R6A tunes 80kc to 30mc, sliderule dial, triple conversion, provision for mechanical filters, AM/SSB/CW. Cost over $1000. Best offer takes it COD. Foss, 1517 N. Main, Walnutcreek, California 94596.

WEST COAST HAMS buy their gear

TELETYPE gear, list for SASE; RD-92A FAX recorder $100.00. Telecom., Box 4117, Alexandria, Va. 22303.

STUDY FOR YOUR FIRST PHONE license at your own pace using the highly-successful Bell & Howell (DeVRY) courses. Contact Bill Welsh (W6DDB) 234 S. Orchard, Burbank, Calif. 91506.

THUNDERBOLT 2KW Linear, factory wired, $200. Heath 2m Pawnee with internal Nuvistor preamp $120. W2UN, 139 Edgeview Lane, Rochester, N.Y. 14618.

CRYSTALS for Regency, Drake, Varitronics, Standard, Galaxy, Tempo FM transceivers and police receivers. Receive – $4.50, Transmit – $5.50, postpaid. Crystals for all applications available – WRITE! Quick Delivery. Derrick Electronics, Box 457, Broken Arrow, Oklahoma, 74012.

ELECTRIC ORGAN full spinet, transistorized, two manual. SASE for particulars. Lloyd G. Hanson, W9YCB, RR2, Box 52A, Angola IN 46703.

MARN Mosaic Amateur Radio Net an association of Masonic amateur radio brethren and members of the appendant Orders. Dedicated to service to mankind and international good will. Write for information. MARN 11049 Avenue E, Chicago, Illinois 60617.

SB-101 WITH HEATH POWER SUPPLY. Compulsively assembled and cared for. Excellent shipping container available. $325.00. William Bank, 764 S.W. Westwood Dr., Portland, Ore., 97201.

MOTOROLA 2 METER FM. Modernized used Motorola FMTRU 41V mobile FM transceivers, 40 watts output, 12 volts d.c. input, transistorized power supply, silicon diodes, front or rear mount, with 24 kHz filter or 6 kHz filter (specify). Many have transistor tone burst oscillator built in. Complete with front mount cable, relay and circuit breaker. $129 w/110V AC/12V DC – regulated supply. $99 W/O. G.E. VOICE COMMANDERS – receiver only $39.95

brought on the basis of a phony TVI complaint, caused by the complainant's own insistence upon using a faultily designed antenna amplifier device. These all demonstrate an all too eager willingness to relegate us to the editor who would not welcome items of public interest which reflect the participation of ham operators. Every ham should appoint himself a committee of one to bring such stories to the attention of the journalistic elements of his own area, so that a meaningful stream of source material may flow forth. This type of publicity can be extremely valuable, for it can open the public's eyes. If the man on the street is unaware of the difference between amateur radio and CB, it is our fault . . . not his. We've simply been too unconcerned to set the record straight. And we ought to make sure that this ridiculous situation is rectified at once.

There should be a central clearing agency formed in order to collate and classify all the printed material which is produced, making it available for republication, the entire country over. A file of pictorials should also be accumulated so that extracted photographs are constantly available for use in conjunction with covering stories.

There is nothing unusual or unprecedented about any of this. It is an every-day, common, garden-variety-type operation, similar to that maintained by every newspaper, magazine and press agency in the nation.

If we are compelled to do something about creating a new image for ourselves, for gosh sakes, why can't it be done on an adequate level? Must it always be on the same scale as the local garden group, the Ladies' Aid, or the boosters' club?

Recently, when I participated in a local hobby show here in Kinnelon, given in the school gym, and they wanted to sandwich my portable amateur station between a crewel embroiderer and a collector of bubble gum baseball cards, I insisted upon being given a completely sequestered position, apart from all the others, placed alone because of the comparatively more serious nature of this particular hobby . . . amateur radio. The committee acceded to my request, and the validity of this was borne out by the fact that the ham exhibit attracted more interest and attention than all the rest of the forty-odd tables put together. It was the hit of the show . . . you should have seen the looks of amazement and delight on those faces when the voices of hams from the USSR, Great Britain, Latin America and other far-flung places came booming through the speaker.

More than a dozen parents inquired about getting their kids involved in ham radio, for it had become evident that all their former ideas and misconceptions had been erroneous. All the previous rumor mongering had been discredited in this simple demonstration. And the time it took in preparation, only a couple of hours, more than justified itself in the result.

There was nothing difficult about this. Every organization is seeking such demonstrations for their programs, and will be delighted to include it. And the local editor will be just as glad to report upon it in the pages of his newspaper. I know this to be true, for I wrote a column about it for the paper for which I do a semi-weekly comment, and it was accepted without question. I invited interested readers to get in touch. A goodly number did; some are now in the process of becoming hams, and others are sending their kids. And the column, reprinted in several other periodicals in nearby towns, has brought inquiries by the score.

I once wrote in this space about a certain physician/ham who had gotten a citation from an African country in which thousands of lives were saved as a result of his shipping an antibiotic. The certificate, signed by the President of that land, stated that the doctor had done more for international goodwill and amnity than a dozen Peace Corps. This is the real function of amateur radio, and it would be tragic if a new interpretation of the regulations were to deny us the continued opportunity to serve it, as we always have.

If we can demonstrate our dedication to this principle of public service, convincing the FCC that we should be encouraged to continue, and then, if we can begin, at long last, to mount a campaign of information and orientation which will educate the hugh mass of people, then we can surely scotch all the accusations that we are nothing but idle hobbyists, playing with gadgetry and gimmickry, like a bunch of overgrown kids.

We must make it abundantly clear to the FCC and to the public at large that amateur radio is an indispensable resource . . . that the role of amateur radio is a necessary and vital one without which the public would suffer an irreparable loss . . . that it renders incalculably important service . . . is responsive to public need . . . that it stands ready to assume meaningful functions in times of catastrophe and disaster, and that therefore it must be maintained in force . . . indeed it must be encouraged to extend its areas of operation . . . not limited and proscribed and restricted to a narrow field of activity.

Let's not lose this thing by default. I hope you will withstand the temptation to neglect or postpone it. Devote a small portion of your time and energy in what may well turn out to be one of the most important issues in our history as hams. Your effort may be the tiny, little grain which will tip the scales in our favor, or which, if lacking, may result in the eventual weakening of our hobby.

Is this challenge going to go unanswered? For all our sakes, I sincerely and profoundly hope not.

K2AGZ■

LETTERS

(Continued from News Page 5)

sion of the radiation angle using the longer antenna (i.e., higher gain).

An excellent fiber glass housing can be obtained from Sears Co. in the form of a telescoping fiber glass "cane pole" in lengths of 16 and 20 ft. The things are hollow up to the tip and structurally ideal. Price varies, but the last one I got two years ago was less than $15 for the 20 ft version. The poles are also available in some of the local discount houses for less money, but the tip section is not always hollow. Shakespear is in the antenna business too, and although they have not been contacted by me as of this letter, they might provide a reasonable housing.

By eliminating the radials and 'peeling' ¼ wavelength of braid back on the feed-line a simple skirt can be used without the mounting problems of the radials. The impedance with this skirt increases from 50Ω to something over 75Ω though, and 75Ω feed-line and antenna elements should be used with the skirt type.

I agree with your findings concerning any filler material within the housing. It does not hurt the antenna to 'slop' around a little. There is definitely a problem caused by using a fiber glass filler or plastic "casting resin." Someone suggested plaster but I have never tried that . . . I suspect ANYTHING wet on the inside will detract from the antenna's performance.

Finally, Glyptal varnish just at the joints will waterproof and protect them. Clear nail polish works, too, and allow the builder to inspect the joints at a later date without damage.

R.E. (Bob) Schlenker WA8ABT
5646 Skyway Drive NE
Comstock Park MI 49321

from Amrad Supply Inc. Send for flyer. 1025 Harrison St., Oakland CA 94607, 451-7755, area code 415.

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each, as is. **LIMITED SUPPLY AT THIS PRICE!** If you have any questions please call 213-271-5845. Al Hoffman, Los Angeles CA 90046.

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TRANSFORMERLESS
power supplies

Donald Kochen K3SVC
1889 August Avenue
Dundalk MD 21222

In the past ten years, amateur radio has shifted emphasis from electron tube to solid state technology. This shift has opened new areas for innovation. Circuitry need not be converted to solid state on a one-to-one basis with the vacuum tube counterpart. Accordingly, the new generation of equipment performs more complex functions while using less components than previously possible. Old ideas can be re-examined in this light and may yield new results.

This article describes a capacitor-input, dual-voltage power supply that is suitable for low power applications. It differs from the line-operated type found in the old ac-dc radios in that the "hot" side of the line is electrically isolated, the output is voltage regulated, and efficiency is high – since the voltage is dropped across a reactive component.

Naturally the safety of such a device immediately comes to mind. Appliance shock hazard is measured in terms of a leakage current, which is that current which results when a wire is connected between ground and the appliance chassis. All appliances have *some* leakage current. In fact, any object that is even near house wiring has *some* voltage induced upon it; to demonstrate this, hook an ungrounded wire to the high-impedance vertical amplifier of a sensitive oscilloscope.

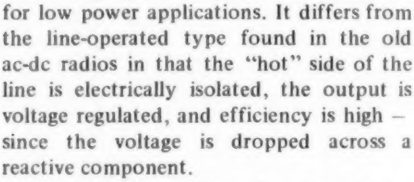
+
RECT FILTER
CONSTANT CUR SINK AND VOLT REG
V1
RL1
CONSTANT CUR GEN
RL2
115V
RECT FILTER
CONSTANT CUR SINK AND VOLT REG
V2

Fig. 1. Transformerless power supply.

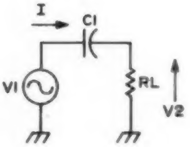

Fig. 2. Ac constant-current generator.

To be acceptable from a safety viewpoint, any leakage current must be minimized to a level consistent with current engineering practices. With this in mind, the capacitor-input power supply can take two different forms, depending on the particular application:

1) The special case, when the device to be powered is electrically insulated from all other equipment and any exposed metal chassis (such as driving a dc relay coil). In this special case the output may be allowed to "float" 115V above ground.

2) The general case, where one output terminal of the supply is electrically connected to a chassis or to some other equipment that has a chassis. In this case the capacitor-input power supply must be used either with a grounded three-conductor ac power receptacle or with an isolation transformer.

A low voltage, low current power supply can find many applications around the hamshack. Many transistorized gadgets such as preamplifiers, frequency converters, electronic keyers, and speech processors need only tens of milliamps to operate. In addition, some IC projects require both positive and negative voltage supplies.

Bench-type variable power supplies are fine for testing equipment, but it is a shame to tie them up powering miscellaneous gadgets. Aside from using a battery, the alternative is to build a separate power supply for each gadget.

Typically, a 6 or 12V filament transformer is used to build the conventional power supply. Most hams have several filament transformers in their junkbox; but they are often "boat anchor" types and are therefore esthetically unsuitable. Rather than purchase a small 1A filament transformer, a power supply can be built as outlined in Fig. 1.

As shown in Fig. 1, the 115V source is converted into a constant current generator. This ac constant current is then split and rectified into a positive and negative constant current. The dc elements are then led into a combination constant-current-sink and voltage regulator. This is a device that will draw a constant current while maintaining a constant output voltage. The purpose of the constant-current-sink is to limit the voltage at the output of the rectifier so that it will be independent of the load resistors RL1 and RL2. This relaxes the voltage tolerance of the filter capacitor. The output voltages and currents are independent of each other.

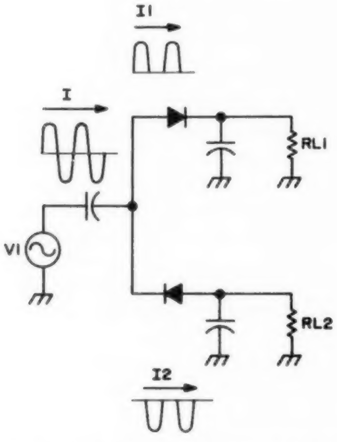

Fig. 3. Rectifier arrangement for independent positive and negative output.

Constant-Current Generator

When a capacitor and resistor are connected in series as in Fig. 2, they will approximate a constant-current generator as long as the reactance of the capacitor is much greater than the resistance. The current flow is determined mainly by the size of the capacitor and is independent of the resistor. This approximation is valid when V1 is much greater than V2. The current available is then:

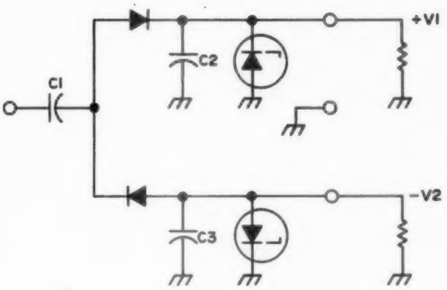

Fig. 4. A simple zener diode will provide effective regulation at loads of up to 1W.

$$I_{(RMS)} \cong \frac{V1}{XC}$$

$$I \cong 115\,(2\pi 60C)$$

$$I \cong 4300\,C$$

or

$$I/C\,(\mu F) \cong 40\ mA/\mu F$$

If a pair of rectifiers and filters are added to this ac constant-current generator, as shown in Fig. 3, the result is a positive current generator and a negative current generator that are independent of each other. Moreover, each generator has an average current capability of one-half the total I, or 20 mA/μF.

The maximum power delivery to the load is

$$P = (I1)^2\ RL1 + (I2)^2\ RL2$$

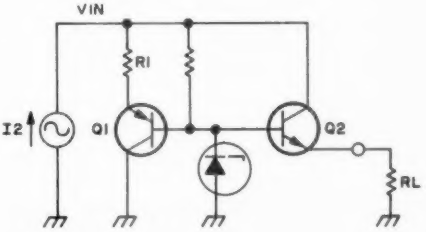

Fig. 5. At heavier loads, a transistor regulator provides better regulation and less ripple.

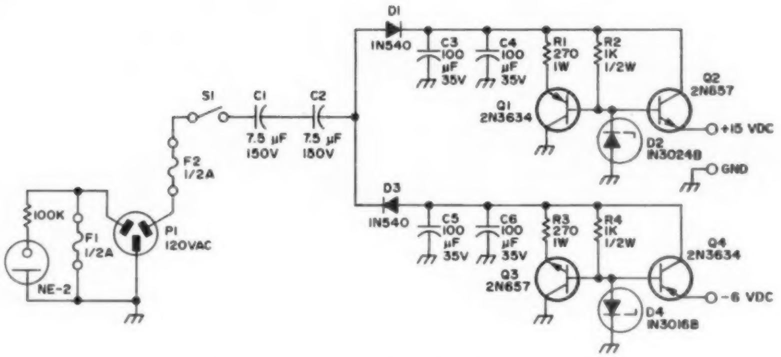
D1
1N540
C3
100
µF
35V
C4
100
µF
35V
R1
270
1W
R2
1K
1/2W
Q2
2N657
S1
C1
C2
7.5 µF
150V
7.5 µF
150V
Q1
2N3634
+15 VDC
D2
1N3024B
GND
F2
1/2A
D3
1N540
C5
100
µF
35V
C6
100
µF
35V
R3
270
1W
R4
1K
1/2W
Q4
2N3634
100K
F1
1/2A
P1
120VAC
Q3
2N657
-6 VDC
D4
1N3016B
NE-2

Fig. 6. Low-voltage transformerless power supply.

Voltage Regulator

The voltage regulator must draw a constant current regardless of the load; otherwise the voltage at C2 would rise up to 115V under light loading. For loads drawing less than 1W, a zener will probably suffice as in Fig. 4. But for loads drawing more than 1W, a transistorized regulator as shown in Fig. 5 will provide better voltage regulation and less ripple. When *RL* is very small, all the current *I2* goes through Q2; when *RL* is very large, all the current goes through Q1. If R1 is chosen to be equal to the smallest load resistance *RL* to be encountered, than the voltage regular will draw a constant current with no appreciable rise in input voltage.

Practical Examples

The circuit of Fig. 6 was constructed to verify performance. Note that a three-prong power plug and receptacle are required to assure a grounded output. The second ground prong is connected through a fuse to the grounded center conductor to guard against improper ac wiring. If the wiring is reversed, this fuse will disable the power supply and the neon bulb fault-indicator will light.

Asymmetrical output voltages of +15V and −6V were selected to demonstrate flexibility. At currents up to 55 mA, the −6V signal had 0.1V ripple; the +15V signal showed a ripple of 0.05V.

Note that the input capacitor must be a nonpolarized type of sufficient voltage rating. In this case, a pair of CL33s were used in series to give a voltage rating of 300V. The effective capacitance of 3.7μF in the current generator led us to expect an average output current capability of about 74 mA (= 3.7μF x 20 mA/μF).

The circuit of Fig. 7 is an example of a simple low-current supply. Again, more output current could be obtained by better filtering.

If a dual supply is not needed, one

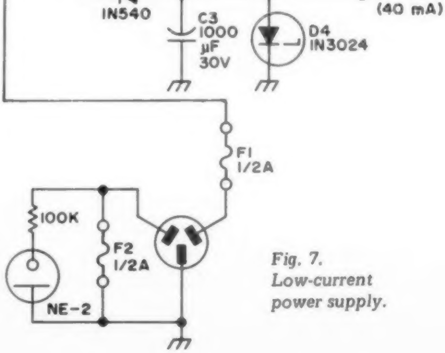
D1
1N540
+14 VDC
(40 mA)
C2
1000
µF
30V
D2
1N3024
C1
2 µF
600V
GND
D3
1N540
-14 VDC
(40 mA)
C3
1000
µF
30V
D4
1N3024
F1
1/2A
100K
F2
1/2A
NE-2

Fig. 7. Low-current power supply.

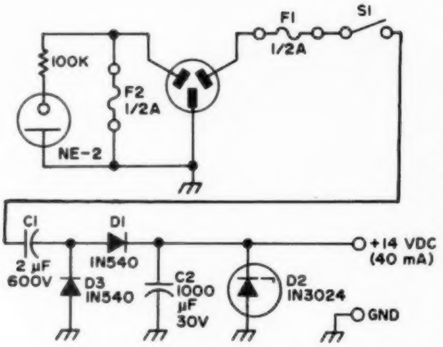
FI
1/2A
SI
100K
F2
1/2A
NE-2
CI
2 μF
600V
DI
IN540
D3
IN540
C2
1000
μF
30V
D2
IN3024
+14 VDC
(40 mA)
GND

Fig. 8. Single-polarity low-current supply.

output polarity can be obtained by simply shorting one of the rectifiers to ground as in Fig. 8.

Two Conductor Wiring

Capacitor-input power supplies must be used with an isolation transformer if three-conductor ac power is not available. This becomes practical if different voltages are needed; since one isolation transformer can power several low-current power supplies. An isolation transformer can be built by the old trick of hooking two surplus filament transformers together as in Fig. 9.

Surplus dc relays are very inexpensive and are readily available at most hamfests. Their major drawback is that they usually require a 24V dc power supply. A capacitor-input power supply can be used to energize most low-power relays.

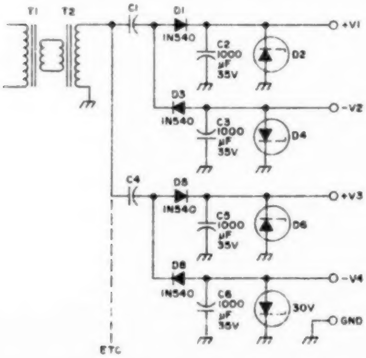
TI
T2
CI
DI
IN540
C2
1000
μF
35V
D2
+VI
D3
IN540
C3
1000
μF
35V
D4
-V2
C4
D5
IN540
C5
1000
μF
35V
D6
+V3
D7
IN540
C6
1000
μF
35V
30V
-V4
GND
ETC

Fig. 9. Back-to-back filament transformers provide isolation where no three-wire ac is available. C1–4 are nonpolar.

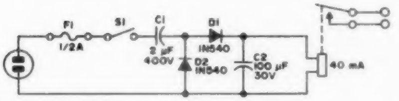
FI
1/2A
SI
CI
2 μF
400V
DI
IN540
D2
IN540
C2
100 μF
30V
40 mA

Fig. 10. The energizing switch should be at the input of the power supply, as shown. The load (relay coil) should be connected to the output of the supply at all times to limit the voltage at C2. For some relays it might not be necessary to filter the supply and in those cases C2 can be eliminated.

When powering low-voltage relays, it is usually not necessary to have a grounded output. No isolation transformer is required if the relay coil is insulated from the chassis. Figure 10 shows a typical relay power supply.

Output current an be doubled by use of a bridge rectifier as in Fig. 11. Since both positive and negative currents are utilized, the output current is 40 mA/μF of C1, or in this case 80 mA. As before, it may be found that the filter capacitor is unnecessary and may be eliminated.

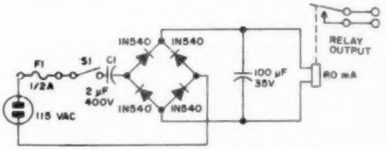
FI
1/2A
SI
CI
2 μF
400V
115 VAC
IN540
IN540
IN540
IN540
100 μF
35V
80 mA
RELAY
OUTPUT

Fig. 11. A capacitor-fed bridge doubles output current capability of power supply.

Conclusion

In this article, I have attempted to illustrate various application techniques of the capacitor-input power supply, rather than give construction details for any one project. Although the circuits described are certainly reproduceable, they are presented in their simplest form and could be improved upon by better voltage regulator and filter design.

Line-operated power supplies require greater care in wiring and an understanding and respect of the potential dangers involved. If you're unsure, stick with the isolation transformer!

K3SVC■

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ATV RESEARCH
13th & Broadway
Dakota City NB 68731

BUILD A SOLID-STATE MODULE TV CAMERA

I imagine almost everyone involved in electronics in this day and age has, at one time or another, wished he had a closed-circuit TV camera for one purpose or the other! Whether it be used around the home to keep an "eye" on the kids or in your business for surveillance purposes a CCTV camera can be an extremely valuable tool. While numerous assembled cameras can be purchased on the market today most of us have that ever present urge to do-it-ourselves!

If you are a little rusty on TV circuit theory, tackling a complete vidicon TV camera yourself might appear to be something more than you bargained for. But such is not the case with this construction article, since the camera we are about to describe makes use of four factory-wired modules (five, if camera is to be battery operated). These modules constitute the entire video, rf, vertical sweep, horizontal sweep, and vidicon B+ circuitry, requiring only a few simple interconnections and miscellaneous external adjustment controls.

This is the simplest and quickest approach to a TV camera that I know of that will still give a person the feeling of building it himself! The constructor can plan his own layout, cabinet to be used, plus get practical experience in assembling the vidicon focus and deflection coils and tuning up the finished camera. Through the use of camera modules, total construction time is cut drastically over a standard hand-wired project. Most constructors should be able to have their camera operating within a matter of one or two evenings.

Theory of Operation

To better understand the description that follows we suggest that you refer to the schematic diagram shown in Fig. 1.

The picture to be televised is optically focused through a lens system onto the light-sensitive target portion of the vidicon tube. The "charged" optical pattern formed on the target is then electronically scanned point by point and line by line from the back side via a sharply focused electronic beam. As the beam travels across the target current is allowed to flow through the target circuit, the intensity of which is proportional to the amount of light at that particular point. Thus the optical image is converted to an equivalent electrical signal.

To properly control the focusing of the electron beam, as well as its intensity, we must provide a means of controlling the screen voltage and the control grid bias. These are provided by the electrical focus

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adjust pot and beam adjust pot shown connecting to pins 6 and 2 of the vidicon, respectively.

The signal current flowing in the target circuit, you will note, flows through a 56 kΩ resistor (target load) and then through a special 1 GΩ resistor. The change in current, as a result of the scanning beam traveling across the light and dark areas of the photosensitive target, causes a voltage drop variation in proportion to the signal current. This variation represents a very low-level video signal that must be amplified by a high-gain, low-noise video amplifier strip.

This is the purpose of the ATV Research Video Module MOD-1. It is a six-stage circuit incorporating high input impedance, 70Ω output impedance, as well as provisions for inserting vertical and horizontal sync-blanking pulses. Stable performance of the output mixer section of this module is achieved through a three-stage feedback circuit. Output of the video module is approximately 1V p-p, standard negative-going sync. The signal from this module is designed to directly drive a standard video monitor, or if desired, drive the MOD-4, a modulated rf oscillator module which makes it possible to feed a conventional TV receiver without the need for modifications.

As mentioned in the preceding paragraph, the signal current flows through the 56 kΩ load resistor and also through a special 1 GΩ resistor. The purpose of this resistor is to provide for automatic light compensation. Basically, it functions as a current-limiting circuit which tends to raise or lower the overall dc target voltage present at the junction of the 56 kΩ resistor and the 0.001 μF capacitor, depending on the average amount of light falling on the vidicon target.

The time constant provided by the 1 GΩ resistor, the .001 μF bypass capacitor, and the input capacitor (in the video module) determines the proper response time of the circuit. Light variations up to 1000:1 can be handled using this sytem without varying the sensitivity of the vidicon tube or the iris on the lens. Should variations greater than this be encountered

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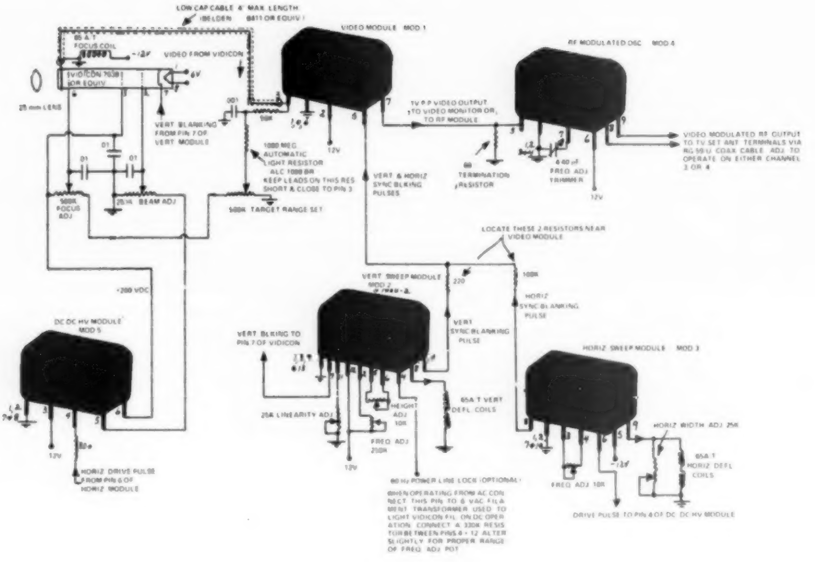

LOW CAP CABLE 4' MAX LENGTH (BELDEN 8411 OR EQUIV)
VIDEO MODULE MOD 1
RF MODULATED OSC MOD 4
65 A T FOCUS COIL
-12V
VIDEO FROM VIDICON
VIDICON 7038 OR EQUIV
6V
25 mm LENS
.001
10K
VERT BLANKING FROM PIN 7 OF VERT MODULE
.01
.01
.01
1000 MEG AUTOMATIC LIGHT RESISTOR ALC 1000 BR KEEP LEADS ON THIS RES SHORT & CLOSE TO PIN 3
12V
500K FOCUS ADJ
250K BEAM ADJ
500K TARGET RANGE SET
VERT & HORIZ SYNC BLKING PULSES
1V P P VIDEO OUTPUT TO VIDEO MONITOR OR TO RF MODULE
68 TERMINATION RESISTOR
4-40 pF FREQ ADJ TRIMMER
12V
VIDEO MODULATED RF OUTPUT TO TV SET ANT TERMINALS VIA RG 59/U COAX CABLE. ADJ TO OPERATE ON EITHER CHANNEL 3 OR 4
LOCATE THESE 2 RESISTORS NEAR VIDEO MODULE
220
100K
HORIZ SYNC BLANKING PULSE
VERT SWEEP MODULE MOD 2
VERT SYNC BLANKING PULSE
+200 VDC
DC DC HV MODULE MOD 5
VERT BLKING TO PIN 7 OF VIDICON
25K LINEARITY ADJ
HEIGHT ADJ 10K
FREQ ADJ 250K
12V
65A T VERT DEFL COILS
12V
HORIZ DRIVE PULSE FROM PIN 6 OF HORIZ MODULE
60 Hz POWER LINE LOCK (OPTIONAL)
WHEN OPERATING FROM AC CONNECT THIS PIN TO 6 VAC FILAMENT TRANSFORMER USED TO LIGHT VIDICON FIL. ON DC OPERATION CONNECT A 330K RESISTOR BETWEEN PINS 4 + 12. ALTER SLIGHTLY FOR PROPER RANGE OF FREQ ADJ POT
HORIZ SWEEP MODULE MOD 3
HORIZ WIDTH ADJ 25K
-12V
65A T HORIZ DEFL COILS
FREQ ADJ 10K
DRIVE PULSE TO PIN 4 OF DC DC HV MODULE

Figure 1

the vidicon sensitivity can be increased or decreased by raising or lowering the target range pot adjustment. Too high a setting of this control will result in excessively contrasty and distorted video while too low a setting will result in washed-out pictures.

Many CCTV users do not have access to a video monitor in which the video output from the camera can be fed directly into the video amplifier of the monitor. Therefore, quite a few users prefer to make use of existing TV receivers; although it is possible to modify these sets to accept the video output from the camera directly into the first video amplifier stage, it is not generally a popular practice. In the first place, many of the present-day receivers are ac/dc devices that present a serious shock hazard when connecting the ground of the set (actually one side of the power line) to another piece of equipment . . . in this case the TV camera. Second, most constructors are not familiar enough with the set to perform the necessary modifications without considerable trouble. Some sets require a video polarity inverter stage, others simply don't have sufficient gain to function properly. Consequently, in these cases, the rf modulated oscillator (MOD-4) is used.

The MOD-4 is a single-stage oscillator incorporating a fixed printed circuit tank coil externally tuned via a 4–40 pF trimmer. Operation is on either of two adjacent low-band channels, depending on which one is vacant in your area. Video from the video module is fed to the oscillator to effectively modulate it, providing a modulated rf output signal that can be received by any standard TV receiver. The 68Ω terminating resistor provides the proper load for the output circuit of the video module and must not be forgotten. (When using the video module to directly feed a video monitor this 68Ω resistor is located at the monitor . . . not at the camera.) Slight alteration of this resistor affords the constructor the opportunity to increase or decrease the modulation level over a moderate range in order to obtain the best possible picture. It's not recommended that a value lower than 39 Ω or higher than 120Ω be used.

Vertical and horizontal sweep, required to deflect the vidicon electron beam up and down and across is obtained by the vertical module (MOD-2) and the horizontal module (MOD-3). Both of these units consist of a blocking oscillator, buffer stage, and output stage. These two modules, together, constitute a complete sync and blanking generator as well as the sweep amplifiers. Both modules allow for external adjustment of the frequency and sweep amplitudes.

In the case of the vertical module, external adjustment of the sweep linearity is also provided . . . this not being required on the horizontal module. The vertical blanking signal feeding the cathode of the vidicon is required to prevent vertical retrace lines from appearing in the televised picture during the periods the beam is returning from the bottom of the target to the top. For technical reasons of little interest, this is not necessary for the horizontal retrace. Both modules also provide a combination sync-blanking pulse which is mixed with the video in the video module to form a composite signal capable of locking the scanning oscillators in the TV receiver.

When the camera is to be powered from the 120V power line it is important to lock the vertical sweep module to the frequency of the power line by connecting line lock pin 4 to one side of the 6V feeding the vidicon filament. In this manner, any residual hum, either in the camera or in the TV set, will appear stationary on the screen rather than "crawling" through the picture.

As can be seen from the schematic, the entire camera can be operated from a low-voltage source of approximately 12V, tapping half way to provide the 6V required to operate the vidicon filament. The only other voltage required is the 200V which can be obtained one of two ways. If it is desirable to operate from the power line, the B+ as well as the low voltages required can be obtained from a transformer supply. A typical recommended circuit is shown in Fig. 2.

Another approach would be to build only the 12V portion of the recommended supply using two 6.3V filament transformers in series. These transformers are readily available from a multitude of electronic distributors and provide a simple means of obtaining the required low voltage. The B+ can then be obtained with the dc-dc B+ module (MOD-5). This is an interesting approach to obtaining the 200V since it takes a drive pulse from the horizontal module, amplifies it, then rectifies and filters it all without the use of

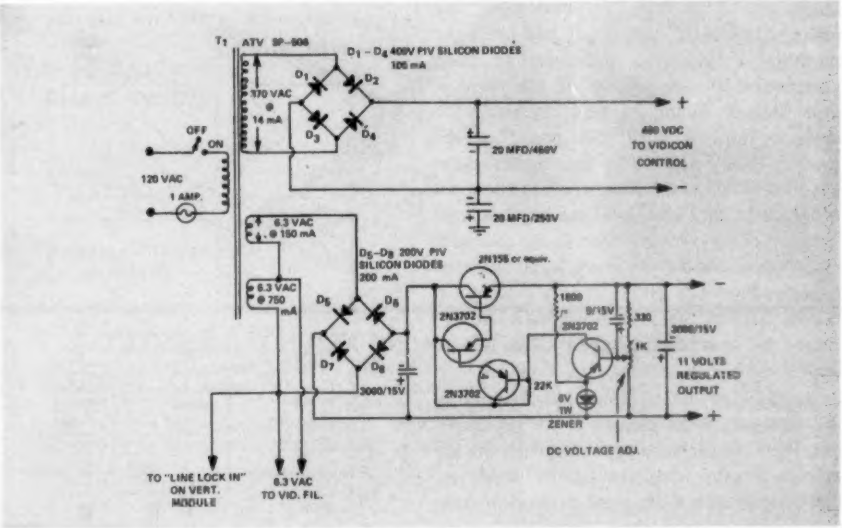
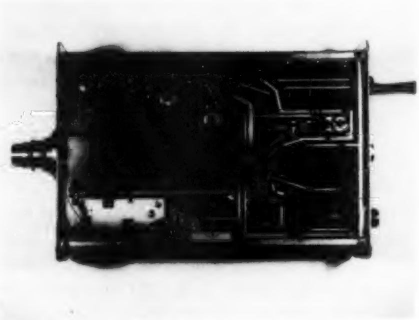

T1 ATV SP-506
D1 – D4 400V PIV SILICON DIODES 105 mA
D1
D2
D3
D4
370 VAC @ 14 mA
OFF
ON
120 VAC
1 AMP.
20 MFD/450V
20 MFD/250V
+
−
400 VDC TO VIDICON CONTROL
6.3 VAC @ 150 mA
6.3 VAC @ 750 mA
D5–D8 200V PIV SILICON DIODES 200 mA
D5
D6
D7
D8
3000/15V
2N155 or equiv.
2N3702
2N3702
2N3702
1800
5/15V
330
1K
22K
3000/15V
6V 1W ZENER
11 VOLTS REGULATED OUTPUT
DC VOLTAGE ADJ.
TO "LINE LOCK IN" ON VERT. MODULE
6.3 VAC TO VID. FIL.

Figure 2



Bottom inside view of camera shows pots and other misc. parts mounted on a master PC board. Note parts are mounted on copper side of board except those related to power suply. This is done to conserve space.

heavy, bulky components. Since the ripple frequency is that of the horizontal sweep (15.75 kHz), very small filter capacitors can be used, thereby keeping the size very small. Of course, the dc-dc module is invaluable for providing the B+ when building a camera to be completely battery operated.

Vidicon Electromagnetic Focusing/Deflection System

Thus far no mention has been made of the manner in which the vidicon is electromagnetically focused or deflected; the prime concern to this point has been the modules themselves. However, to fully understand the operation of the camera, you should spend a few moments to become familiar with this phase of the camera also. Since the camera modules have been designed to incorporate the most economical and the most readily available vidicon tubes (namely the 1 in. diameter electromagnetically focused and deflected types such as the 7038, 7735A, 6326A), it is only natural that it be designed to accept presently available focus and deflection coils.

A detailed description on assembling this portion of the camera is not necessary since the instructions provided with the kit of coils is quite adequate. Briefly, however, the vertical and horizontal deflection coils are mounted on a form large enough in diameter to allow the vidicon to slip into it. This assembly, known as a yoke, fits into the focus coil which envelops the entire front end portion of the tube. The vidicon target ring seats into the target connector located in the front end of the focus coil.

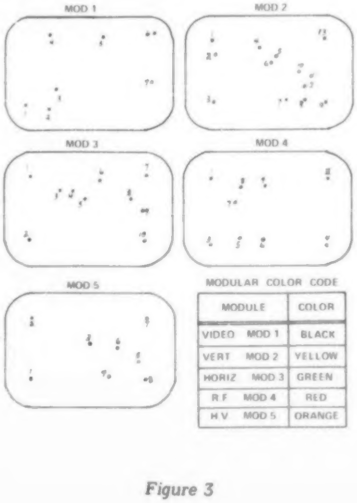
The first question that usually comes to mind involves the use of a focus coil: Isn't the tube electrostatically focused? Yes, it *is* electrostatically focused – but it is also electromagnetically focused. The vidicon tube incorporates a unique low-velocity scanning system and requires an axial magnetic field to produce a one-loop spiral path from the electron gun to the target. This is produced via the external focus coil. Fine adjustment is provided by the electrostatic focus adjust pot which varies the voltage on the grid (pin 6) of the tube.

General Hookup Instructions

Whether you are using all five of the modules to build your TV camera or just some of them, keep the following points in mind.

Always be certain you make the correct connections to the proper pins; otherwise serious damage may result to the module!

Use the schematic diagram shown in Fig. 1 and the module pin layouts shown in Fig. 3 to determine the proper connection of the pins to the rest of the circuitry and to the other modules.



MODULAR COLOR CODE

MODULE	COLOR
VIDEO MOD 1	BLACK
VERT MOD 2	YELLOW
HORIZ MOD 3	GREEN
R F MOD 4	RED
H V MOD 5	ORANGE

Figure 3

STEP UP TO TELREX

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2M609	- "Monarch", 14 DBD, 6 El., 6 KWP, 1" O.D, 9' boom	$ 39.95
2M814	- "Monarch", 16 DBD, 8 El., .8 KWP, 1.375" O.D, 14' boom	$ 59.00
6M516	- "Monarch", 13 DBD, 5 El., .8 KWP, 1.5" O.D, 16' boom	$ 63.95

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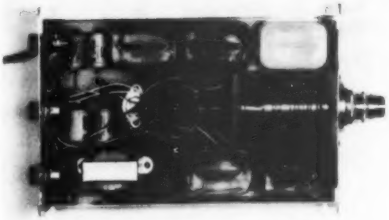
Double-check all connections before applying power.

Locate the video module near the front of one side of the focus coil to allow a short lead to connect from it over to the target connector. Place the rf module near the rear of the focus coil on the same side. Place the vertical module on the opposite side of the focus coil near the front and the horizontal module on the same side, near the rear of the focus coil. The B+ module can be placed near the back of the camera close to the horizontal module. As in all good engineering, keep leads short and direct.

Extra grounds have been provided on each of the modules. These can generally all be grounded; however, in certain instances, depending again on individual construction layout and wiring practices, this may result in a ground loop being formed. Most often this will occur in the video amplifier stages since this is an extremely high-gain unit. When it happens, most often it will result in a self-oscillation. By removing one or more of the grounds and grounding them to different points on the chassis, this condition can be quickly and easily corrected.


Top inside view of camera showing the lens, lens mount, focus-deflection coil assembly, vidicon tube, power supply to rear and the five modules. The module order is; from front to back: Video module and RF module on the side with the power transformer; Vertical module, horizontal module and HV module on opposite side. Power supply filter capacitors, transistors and rectifiers are shown occupying the rear portion of the camera. Beam, focus and target pots shown on rear panel.

Science students and other experimenters desiring to breadboard the camera for demonstration or lab purposes should keep one more thing in mind. The front of the vidicon is extremely sensitive to rf signals such as those radiated by local AM broadcast stations. If you are planning a breadboard camera be sure to use a metal panel for at least the front end of the camera for mounting the focus coil and lens. This panel should also fold back to shield the video module . . . otherwise rf interference might render the camera inoperational. Total shielding of the front end of the camera is not usually required, except in high interference areas, but at least partial shielding is always required.

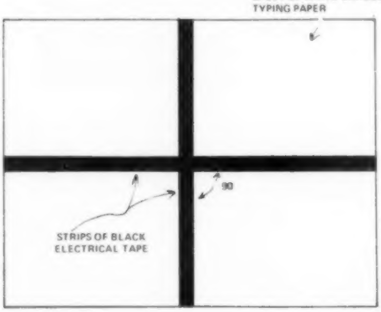

ORDINARY 8½" x 11" SHEET OF WHITE UNRULED TYPING PAPER
90
STRIPS OF BLACK ELECTRICAL TAPE

Figure 4

Both link output coupling and capacitive coupling have been provided on the rf module. The schematic shows it hooked up for link. However, depending on the TV set used and length of line, the capacitive coupling may provide the best picture. In this case connect the TV set to terminals 2 and 9 rather than 8 and 9.

Deluxe installations may desire switchable video and rf outputs. This is entirely practical. Just remember to keep leads short and direct.

Tuneup Instructions

Tuning up the camera is really easy if you will simply follow the procedure outlined below;

1. Begin by setting the beam pot to maximum negative voltage; the target pot to +80V; focus pot to +110V; horizontal width to maximum resistance; horizontal

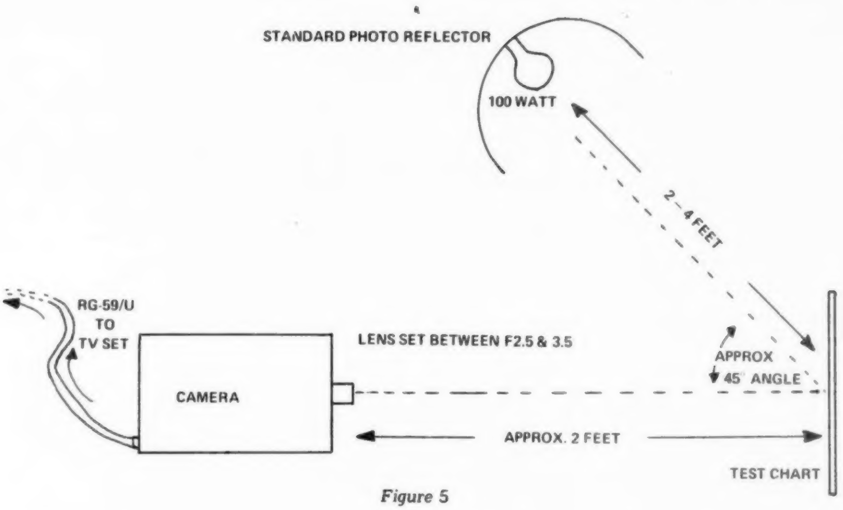


Figure 5

and vertical frequency pots to mid-range; vertical linearity pot to maximum resistance; vertical height pot to minimum resistance; and, if used, the regulated dc adjust pot in the ac power supply to mid-range.

2. Make a simple test card by attaching ordinary black electrical tape to an 8½ x 11 in. sheet of white paper. (See Fig. 4.) Place one piece of tape horizontally across the center of the paper. Place the other piece vertically across the paper thereby forming a + pattern. This pattern is a preliminary test aid only; it is used only for initial setup adjustments.

3. If a video monitor is used, connect the output of the video module to the input of the monitor. If a conventional TV set is used connect the output of the rf module to the antenna terminals of the set using RG-59/U cable. It makes no difference which terminal you use for the outer ground braid. When connecting to a TV monitor be sure the terminating resistor is located at the monitor and not at the camera!

4. Before turning on the camera, tune in a local broadcast station on your set and make all necessary horizontal and vertical hold adjustments. Also, remember, the linearity of your camera can be no better than that of the monitor. Therefore, be sure the height and linearity controls on the TV set are properly adjusted before proceeding with the camera tuneup. Some stations still transmit a short period of test pattern in the morning prior to regular broadcasting. This is very helpful in setting up the receiver.

5. Turn on the power and allow about 1 minute for the vidicon heater to reach operating temperature. *Do not advance beam pot! Keep beam grid at maximum negative voltage!*

6. Set the regulated DC ADJ pot in the regulated power supply (if used) for −11V. Even though the schematics show −12V, in actuality it is −11V when using the recommended regulated supply. If batteries are used, the value can be anywhere between 9 and 12V with best operation being obtained when operating near the higher voltage.

When using batteries, it is necessary to connect between 1000 and 3000 μF across the battery to prevent feedback problems between modules as the batteries age and their internal resistance increases. An alternate approach to this feedback problem would be to use a separate battery to power the video module. Even then, however, a few hundred microfarads of bypass capacity would be advisable to prevent possible trouble as the battery ages.

7. If the rf output module is being used, set the TV receiver to either of the two

operating channels depending on which one is vacant in your area. Adjust the 4–40 pF trimmer until black sync bars appear on the screen. Next, adjust the horizontal frequency pot to lock the horizontal oscillator to the TV receiver.

8. Now adjust the vertical frequency pot until the vertical oscillator is locked to the TV set.

9. Uncap the lens and slowly begin to advance the beam pot (decreasing the negative bias voltage on grid 1 of the vidicon) until a "wiping" effect occurs across the screen. You should now see something that resembles the + chart. For this test, camera-to-chart distance should be about 2 ft and about 100W of illumination 2–4 ft away on a 45° angle, should be used (see Fig. 5). No doubt the picture will be quite poor at this point . . . badly distorted, etc. This is normal since the sweep adjustments have yet to be accurately set.

10. Grasping the rear end of the yoke form, notice that a slight up and down movement of the yoke will cause the scanned target image to shift position on the monitor screen. Insert the necessary shims between the yoke and focus coil until the raster is centered both vertically and horizontally on the monitor screen. Be sure to shim sufficiently to provide a tight fit between the yoke and the focus coil, in order that correct orientation is maintained no matter what position the camera will be operated in.

11. Now adjust the vertical height and linearity pots until the target image just fills out the monitor screen and is as linear as possible. Correct sweep is indicated when the edges of the screen are just filled out with the picture, that is, until no signs of the edges of the vidicon target appear in the televised picture. To determine best linearity, tilt the camera up and down while observing the width of the horizontal test pattern bar. It should remain essentially the same size from the top of the screen to the bottom.

12. Next, adjust the horizontal width pot until the height-to-width ratio appears proportionate. This can be touched up later with the aid of a circle pattern, adjusting for the best shape.

13. All the tests should have been performed with the lens iris at approximately f2.5 or f3.5. To this point, quite likely results have been considerably less than ideal. But don't be alarmed. When setting up a camera the first time, it is difficult to get good results right off due to the number of adjustments required. However, in the next couple of steps picture quality should improve tremendously, resulting in a TV signal approaching the quality you are accustomed to viewing on regular broadcast TV.

14. Adjust the lens focus for sharpest image then adjust the focus adjust pot next for the sharpest image. Recheck the beam pot again to make certain it is correctly set to *just* discharge the entire scanned target. Insufficient discharging will result in washed out highlights. Excessive beam current (decreasing negative bias too much) will result in defocusing, poor shading, and possible damage to the vidicon if left uncorrected too long.

15. If the picture tears, pulls, or goes out of sync it is probably due to excessive target voltage or incorrect adjustment of the rf oscillator 4–40 pF trimmer. Check both adjustments and set for best performance. Too low a target setting will result in low-contrast pictures, so don't go any lower than necessary to obtain a good stable signal.

16. Should the picture appear tilted, upside down, or inside out make the following alteration to the deflection yoke: If picture is tilted, rotate the yoke slightly while monitoring results on the TV set. If picture is upside down or backward, reverse the vertical or horizontal leads until a "right-reading," right-side-up picture is obtained.

17. Upon completion of step 16 it may be necessary to make minor corrections on the yoke shims for correct centering of the target scan.

18. Now go back and repeat the adjustments. The second time around goes very quickly and is well worth the added effort.

You should now be ready to enjoy many trouble-free hours of televising, using the solid-state module TV camera you have successfully built. . . .W0KYQ■

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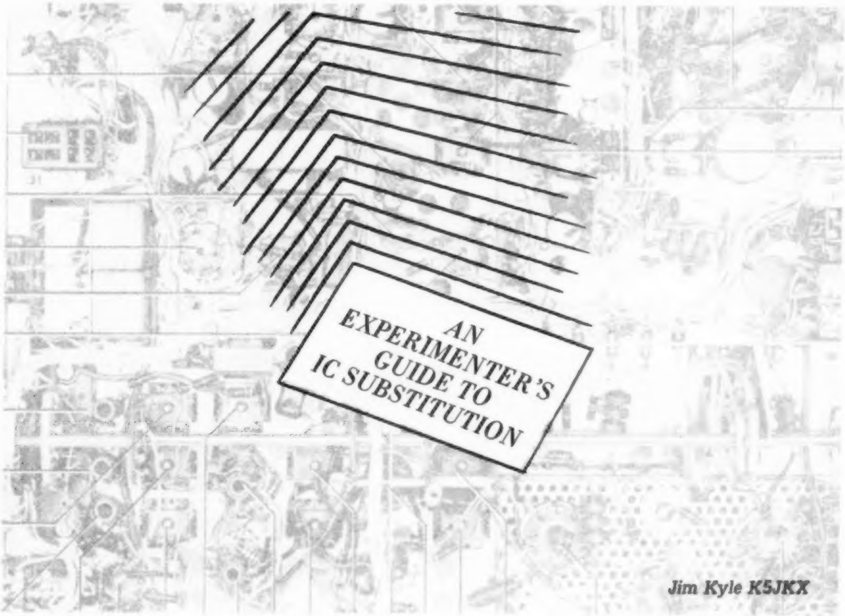

AN EXPERIMENTER'S GUIDE TO IC SUBSTITUTION

Jim Kyle K5JKX

As the insidious integrated-circuit chip makes its way ever deeper into the heart of electronics, more and more construction articles are devoted to IC projects. While some purists (probably the same ones who used to build their own vacuum tubes) may object to this trend, it's probably all for the better – because the ICs result in more uniform and predictable circuits and permit us to homebrew devices which only a few years ago were simply too much trouble for any but the most dedicated of homebrewers.

But there *is* one thing wrong with ICs: there are just too many different kinds of them on the market. The same thing is going on that happened when vacuum tubes made their debut, and much more recently with transistors. Every different manufacturer has his own set of identification numbers, and most of the IC makers concentrate on original-equipment-manufacturer sales so that their products are not the easiest of things to find in the neighborhood parts house.

This means that many worthwhile projects simply never get built by many of us, because the particular IC which is at the heart of the project is difficult for us to obtain.

Fortunately, at least one major manufacturer of ICs has recognized this problem, and is marketing a much-simplified portion of his product line to hobbyists, experimenters, and professionals through the standard parts-house outlets.

What's more, every one of the ICs in this line can substitute for several other types of ICs in both the manufacturer's regular product series, and those of other IC makers. All that's necessary, then, to make many projects feasible is a cross-reference table (like the popular transistor-substitution books) – and that's what this article is all about.

The manufacturer involved is Motorola, and the product line is called "HEP" (for *hobbyist, experimenter, professional* – the three classes of users for whom the line is intended). The HEP line contains many semiconductors in addition to IC chips, but here we're interested only in the ICs. Since additions to the line are constantly being made, this may not cover all HEP ICs by the time it reaches print, but it does describe all which are in catalog HMA 35 (released in mid-1970).

Four classes of ICs are included: three of these are *digitals* or computer-type circuits, and the fourth is *linears* or amplifier circuitry.

The three families of digital ICs include one group of emitter-coupled logic units and two groups of "TRL" devices; the two families of RTL are "milliwatt" and "medium power" units.

Most published circuits using digital ICs are built around medium–power RTL devices, since the first inexpensive such ICs were in this family.

The four families in the HEP line are: HEP 553, HEP 554, HEP 556, and HEP 558, emitter-coupled logic digitals?s; HEP 570, HEP 571, HEP 572, and HEP 584, medium-power RTL; HEP 580, HEP 581, HEP 582, and HEP 583, milliwatt RTL; and HEP 590, HEP 591, HEP 592, and HEP 593, linear.

We won't go into the ECL (553–558) very deeply, since ECL logic circuits differ somewhat from the more familiar ones.

In RTL, the 570–572 are 14-pin dual-inline packages (DIPs) and the 580–584 are in 10-lead TO-5 transistor cans (HEP 453 is the flatpack socket, while HEP 451 fits the 10-lead units).

The HEP 570 is a quadruple 2-input *nor* gate (four identical 2-input gates in one package but electrically independent). The HEP 571 is a dual buffer. The HEP 572 is a dual J–K flip-flop.

The HEP 584, final member of this medium-power RTL family is a dual 2-input *nor* gate, equivalent to halfof a HEP 570.

The HEP 580 is a dual 2–input *nor* like the HEP 584 except that the 580 is a milliwatt unit requiring, and producing, less power. The HEP 581 is a 4–input *nor* while the HEP 582 is a dual buffer but has two inputs to each buffer permitting it to be used as a dual 2–input *nor* also. (The 581 has an inverter built in which permits it to be used as a 4–input *nor* also.) The final member of the milliwatt RTL family, the HEP 583, is a dual J–K flip–flop.

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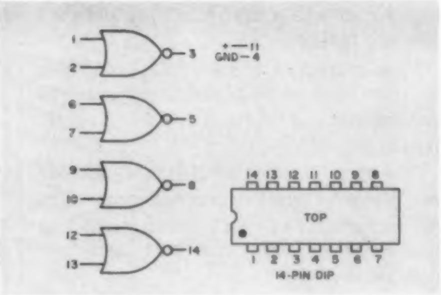
To make it simple to use these units to replace other types of ICs which may be called for in various projects, we've prepared a series of charts which show the pin connections for each, together with certain key characteristics such as maximum voltage and required current, and a listing of the other IC types which the HEP unit can replace. Interchangeability information is taken from data published by Motorola.

Frequently, several HEP units may be shown as being interchangeable with the *same* type of IC. For instance, both the HEP 584 and the HEP 570 show interchangeability with the Fairchild uL914. This comes about because the interchange works only one way; the 584 is an exact substitute, while the 570 has twice as many elements in a different case.

HEP 570

BASE DIAGRAM:


1
2
3
+—11
GND—4
6
7
5
9
10
8
12
13
14
14 13 12 11 10 9 8
TOP
1 2 3 4 5 6 7
14-PIN DIP

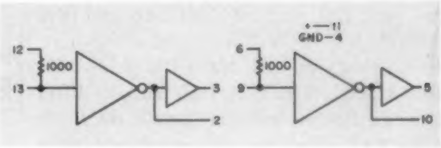
Maximum signal voltage: ±4.0V
Maximum supply voltage: +12V
Operating temperature range: +15 to +55°C
Output current: 2.65 mA per gate element
Package: 14-pin dual inline (socket HEP 453)

REPLACES:

Motorola	MC717P (requires more power)
	MC724P
	MC817P (temperature range is smaller)
	MC824P (temperature range is smaller)
Fairchild	uL914 (570 has four gates, 914 only 2, and package is different)
	U5B991429X (570 has 4 gates, U5B991329X has only 2)

HEP 571

BASE DIAGRAM:


12
1000
13
3
2
+—11
GND—4
6
1000
9
5
10

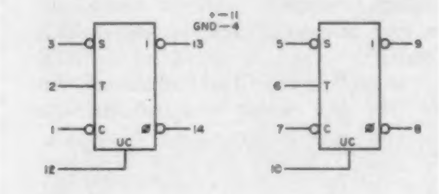
Maximum signal voltage: ±4.0V
Maximum supply voltage: +12V
Operating temperature range: +15 to +55e +55°CC
Package: 14-pin dual inline (socket HEP 453)

REPLACES:

Motorola MC799P	
	MC899P (temperature range is smaller)
Fairchild	uL900 (571 has 2 units, 900 only one)
	U5D990029X (two units instead of one)
Other	PL990029 (two units instead of one)

HEP 572

BASE DIAGRAM:


+—11
GND—4
3
S
1
13
2
T
1
C
Ø
14
UC
12
5
S
1
9
6
T
7
C
Ø
8
UC
10

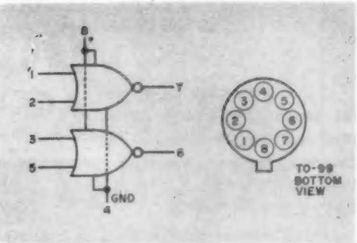
Maximum signal voltage: ± 4.0V
Maximum supply voltage: + 12V
Operating temperature range: +15 to + 55°C
Package: 14-pin dual inline (socket HEP 453)

REPLACES:

Motorola	MC776P (requires more power)
	MC790P
	MC876P (smaller temperature range)
	MC890P (smaller temperature range)
Fairchild	uL923 (two units instead of one)
	U5B992329X (two units instead of one)
Other	PL992329 (two units instead of one)

HEP 580

BASE DIAGRAM:



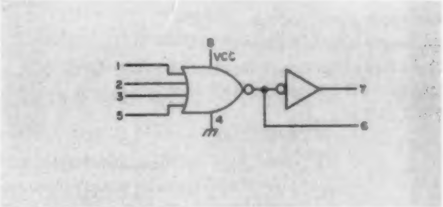
Maximum signal voltage: ±4.0V
Maximum supply voltage: +12V
Operating temperature range: +15 to +55°
Package: TO-99 (8-lead transistor-sized, socket HEP 454)

REPLACES:

Motorola	MC710G
	MC810G (smaller temperature range)
	MC910G (smaller temperature range)
	MC710F (different package)
	MC810F (different package, smaller temp. range)
	MC910F (different package, smaller temp. range)
TI	SN17810L (smaller temperature range)
	SN17910L (smaller temperature range)
Fairchild	U5B991021X
	U5B991029X
Other	PL991021 (smaller temperature range)
	PL991029

HEP 581

BASE DIAGRAM:



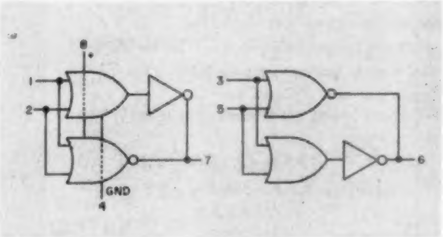
Maximum signal voltage: ±4.0V
Maximum supply voltage: +12V
Operating temperature range: +15 to +55°C
Package: TO-99 (socket HEP 454)

REPLACES:

Motorola	MC711G
	MC711F (different package)
	MC811G
	MC811F (different package)
	MC911G (smaller temperature range)
	MC911F (different package, smaller temp. range)
TI	SN17811L (smaller temperature range)
Fairchild	uL911 (lower power ratings)
	U3F991129X (different package)
	U5B991129X
	U5F991121X (different package)
Other	PL991129

HEP 582

BASE DIAGRAM:



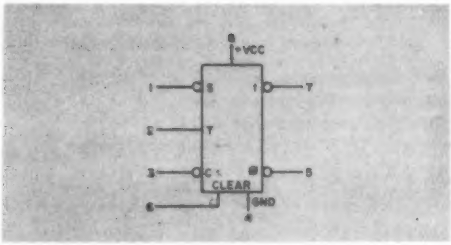
Maximum signal voltage: ±4.0V
Maximum supply voltage: +12V
Operating temperature range: +15 to +55°C
Package: TO-99 (socket HEP 454)

REPLACES:

Motorola	MC781G
	MC881G (smaller temperature range)
	MC981G (smaller temperature range)
Fairchild	U5D990029X (lower power ratings)

HEP 583

BASE DIAGRAM:



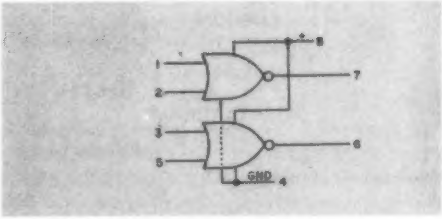
Maximum signal voltage: ±4.0V
Maximum supply voltage: +12V
Operating temperature range: +15 to +55°C
Package: TO-99 (socket HEP 454)

REPLACES:

Motorola	MC782G
	MC882G (smaller temperature range)
	MC982G (smaller temperature range)
Fairchild	U5B992329X (lower power ratings)
	uL923 (lower power ratings)
Other	PL992329 (lower power ratings)

HEP 584

BASE DIAGRAM:



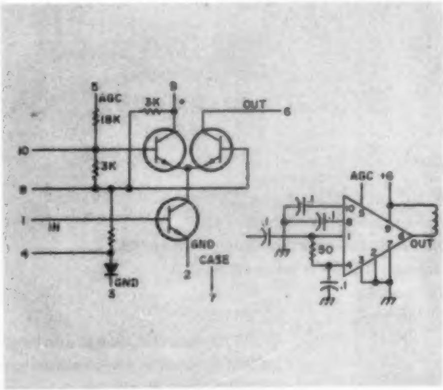
Maximum signal voltage: ±4.0V
Maximum supply voltage: +12V
Operating temperature range: +15 to+55°C
Package: TO-99 (socket HEP 454)

REPLACES:

Motorola	MC714G.
	MC714F (different package)
	MC813G (smaller temperature range)
	MC814F (different package, smaller temp. range)
	MC914F (different package, smaller temp. range)
Fairchild	uL914
	U3F991421X (different package)
	U3F991422X (different package)
	U5B991421X
	UB5991422X
	U5B991319X
Other	PL991429

HEP 590

BASE DIAGRAM:



Maximum signal voltage: 5V rms
Maximum supply voltage: +20V
Operating temperature range: −55 to +125°C
AGC supply voltage (max.): 20V
Supply current: 2.5 mA dc
Package: 10-lead TO-5 (socket HEP 451)

REPLACES:

RCA	CA3002
	CA3003
	CA3004
Motorola	MC1550G
GE	PA713
	PA7601
Fairchild	U5D770339X

WHY DO SMALL COMPANIES ADVERTISE IN 73?

Because the ad rates are cheaper than the other magazines?

Because they get more sales per advertising dollar spent?

Because their ads get better visibility in 73?

Because they like 73 better?

Whether they love us or hate us, the answer is that they get more sales per advertising dollar spent than in any other magazine. This is why you see the dozens of small ads in 73. Larger companies have no practical way of measuring the effectiveness of their ads and tend to advertise where they can get the biggest discounts or with the magazines that make the most outrageous circulation claims. Small companies either get their ad money back from their ads or else they go out of business, so they watch the results like a hawk and are quick to change magazines when they think they can get an advantage.

It takes a minimum of about $10 in sales to amortize $1 in ads, if you figure a 10% gross profit. This is the break-even point.

AND WHERE ARE THE SMALL MAIL ORDER COMPANIES ADVERTISING?

You can put the magazines side by side and count for yourself, so no one can con you. You will find that they are about as they were in a recent issue where . . .

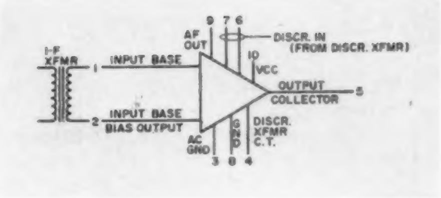
73 . . 70 mail order advertisers
QST . 49 mail order advertisers
HR . 31 mail order advertisers
CQ . . 28 mail order advertisers

Now which of the four magazines do you suppose is doing the best job of selling the ham market?

Call Aline, at 603-924-3873

HEP 591

BASE DIAGRAM:

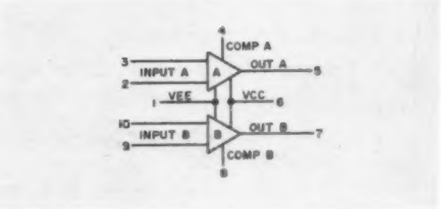

9
7
6
AF OUT
DISCR. IN (FROM DISCR. XFMR)
I-F XFMR
1
INPUT BASE
10
VCC
OUTPUT COLLECTOR
5
2
INPUT BASE
BIAS OUTPUT
GND
DISCR. XFMR C.T.
AC GND
3
8
4

Maximum signal voltage: ±3V p-p
Maximum supply voltage: +10V
Supply current: 27 mA max., I2 mA min.
Operating temperature range: –55 to +125°C
Typical voltage gain: 60 dB min.
Package: 10-lead TO-5 (socket HEP 451)
REPLACES:

RCA	**CA3013**
	CA3014
Motorola	**MC1314G**

HEP 592

BASE DIAGRAM:


4
COMP A
3
INPUT A
2
A
OUT A
5
1
VEE
VCC
6
10
INPUT B
9
B
OUT B
7
COMP B
8

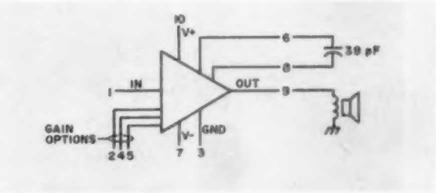
Maximum signal voltage: ±2V p-p
Maximum supply voltage: +16V pin 6 to pin 1
Voltage gain (each channel): 10,000 typical
Output voltage swing: 4.5V p-p min., 5.5V p-p typical
Operating temperature range: 0 to +75°C
Package: 10-lead TO-5 (socket HEP 451)
REPLACES:

Motorola	**MC1302G**
	MC1302P (different package)
	MC1303P (different package, differnt power level)

May replace type 709 opamps with modifications of compensation network values; each 592 is equivalent of two 709s.

HEP 593

BASE DIAGRAM:


10
V+
6
39 pF
8
1
IN
OUT
9
GAIN OPTIONS
V-
GND
2 4 5
7
3

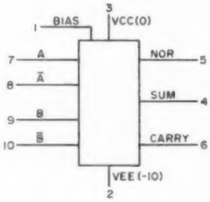
Maximum signal voltage: not rated; has 3–way gain option
Maximum supply voltage: 18V
Supply current: 15 mA max. (no signal), 0.5A (peak signal)

Audio output power: 1.8W
Operating temperature range: –55 to +125°C
Package: 10-lead TO-5 (socket HEP 451)
REPLACES:

Motorola	**MC1554G**

HEP 553

BASE DIAGRAM:

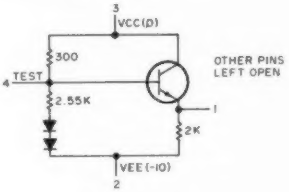

1
BIAS
3
VCC(0)
7
A
8
Ā
9
B
10
B̄
NOR
5
SUM
4
CARRY
6
VEE(-10)
2

Maximum signal voltage: –10V
Maximum supply voltage: –10V
Operating temperature range: +15 to +55°C
Package: 10-lead TO-5 (socket HEP 451)
REPLACES:

Motorola	**MC303G**
	MC303F (different package)
	MC353G
	MC353F (different package)
Other	**SW303F (different package)**
	SW303T
	SW353F (different package)
	SW353T

HEP 554

BASE DIAGRAM:

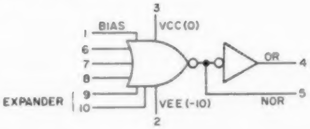

3
VCC(0)
300
OTHER PINS LEFT OPEN
4
TEST
2.55K
1
2K
VEE(-10)
2

Maximum supply voltage: –10V
Operating temperature range: +15 to +55°C
Package: 10-lead TO-5 (socket HEP 451)
REPLACES:

Motorola	**MC304G**
	MC304F (different package)
	MC354G
	MC354F (different package)
Other	**SW304T**
	SW304F (different package)
	SW354T
	SW354F (different package)

HEP 556

BASE DIAGRAM:

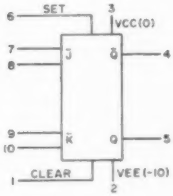

3
1
BIAS
VCC(0)
6
7
8
OR
4
EXPANDER
9
10
VEE(-10)
NOR
5
2

Maximum signal voltage: –10V
Maximum supply voltage: –10V
Operating temperature range: +25 to +55°C
Package: 10-lead TO-5 (socket HEP 451)
REPLACES:

Motorola	**MC306G**
	MC306F (different package)
	MC356G
	MC356F (different package)
Other	**SW306T**
	SW306F (different package)
	SW356T
	SW356F (different package)

HEP 558

BASE DIAGRAM:


6
SET
3
VCC(0)
7
8
J̄
Q̄
4
9
10
K̄
Q
5
1
CLEAR
VEE(-10)
2

Maximum signal voltage: –10V
Maximum supply voltage: –10V
Supply current: 21mA
Operating temperature range: +15 to +55°C
Package: 10-lead TO-5 (socket HEP 451)
REPLACES:

Motorola	**MC308G**
	MC308F (different package)
	MC358G
	MC358 (different package)
Other	**SW308T**
	SW308F (different package)
	SW358T
	SW358F (different package)

. . . K5JKX■

a new name
a new value
...the great new team by TEMPO

TEMPO "ONE" SSB TRANSCEIVER

TEMPO "2000" LINEAR AMPLIFIER

The TEMPO "ONE" SSB transceiver represents the culminating achievement of many years of experience in the amateur radio field. Modern design, superb performance, high styling, sturdy construction, outstanding reliability, exceptional value . . . all these factors combined for the first time in an amateur SSB transceiver make the TEMPO "ONE" the obvious choice in today's amateur market. Power input: 300 watts PEP SSB, 240 watts CW. Five band coverage: 80 through 10 meters. VFO range: 500 khz. Complete with: Selectable Sideband, Crystal Calibrator, VOX, Receiver Off-set Tuning. Price: $298.00. AC/ONE power supply 117/230 volt 50/60 cycle . . . $99.00 DC/ONE power supply 12 volts DC . . . $107.00

The TEMPO "2000" is the smallest self-contained, full legal-limit kilowatt amplifier in its price range. It has an entirely self-contained, solid-state power supply that makes it fully operational within three seconds from turn-on. The "2000" provides full kilowatt input on all modes, band-switched 80 through 10 meters, and grounded-grid input for maximum compatibility with modern transceivers and transmitters. Look at the features . . . the price . . . look at the features . . . you can't do better for only $395.00.

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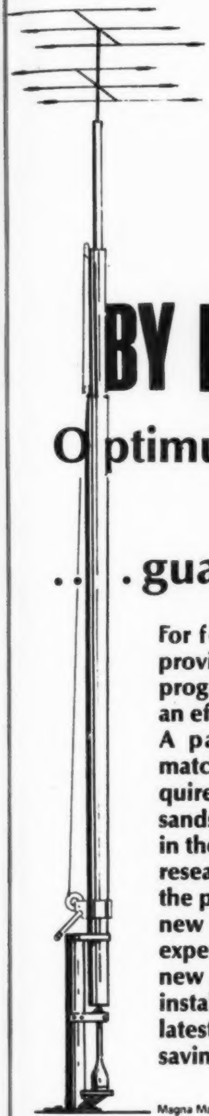

Magna Mast illustrated

ANTENNA PACKAGES BY HENRY RADIO

Optimum performance ...fast service ... .guaranteed savings

For four years Henry Radio has been providing a beam antenna-tower program for amateurs who wanted an efficient, but economical package. A package pre-engineered, pre-matched and pre-packaged to his requirements and pocketbook. Thousands have benefited from this offer in the past. And now Henry Radio has researched the field and up-dated the program ... including the unique new tubular design Mini Mast for less expensive installations and the great new Magna Mast for the more deluxe installations. Now you can get the latest components at the same great savings.

HR-"Mini" Antenna Package

Tristao MM-35 "Mini-Mast"* tubular tower — crank-up
CDR AR-22R Rotator**
100 ft. RG-58A/U Coax
100 ft. 4 Cond. rotor cable
Complete with one of the following antennas:

Hy-Gain TH2MK3	**$260.00**
Hy-Gain TH3JR	**$260.00**
Hy-Gain Hy-Quad	**$290.00**
Hy-Gain 203BA	**$295.00**
Hy-Gain TH3MK3	**$300.00**

*MB-10 Free standing base, add $36.95
**TR-44 Rotator and cable, add $35.00

HR-"Standard" Antenna Package

Tristao CZ-454 crank-up tower w/mast*
CDR TR-44 rotator**
100 ft. RG-58A/U Coax
100 ft. Control cable
Complete with one of the following antennas:

Hy-Gain DB10-15A	**$585.00**
Hy-Gain Hy-Quad	**$600.00**
Hy-Gain 204BA	**$620.00**
Hy-Gain TH3MK3	**$615.00**
Hy-Gain TH6DXX	**$645.00**

*Free-standing base, add $10.00
**Ham-M rotator, RG-8/U Coax, add $50.00

HR-"Magna" Antenna Package

MA-490 "Magna-Mast"
MARB-40 Rotor base
CDR Ham-M Rotator
100 ft. RG-8/U Coax
100 ft. Control cable
Complete with one of the following antennas:

Hy-Gain TH3MK3	**$745.00**
Hy-Gain 204A	**$750.00**
Hy-Gain TH6DXX	**$775.00**

The Magna Mast is ideal for stacked arrays. Write for a quotation on the antenna of your choice.

Freight prepaid to your door in the Continental U.S.A. west of the Rockies. For shipment east of the Rockies add $10.00. Substitutions may be made ... write for prices.

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TED HENRY (W6UOU) **BOB HENRY** (WOARA) **WALT HENRY** (W6ZN)

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931 N. Euclid, Anaheim, Calif. 92801 714/772-9200
Butler, Missouri 64730 816/679-3127

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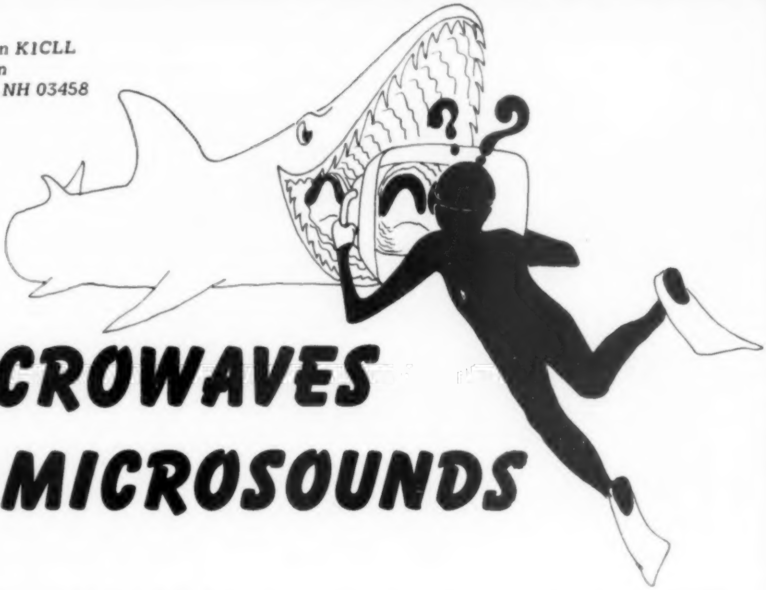
Far Over Farm
Peterborough NH 03458



MICROWAVES & MICROSOUNDS

Those of you who have been following my articles in 73 know that I am, basically, a tinkerer. I love to take a new component and see what I can do with it. It may be a 432 MHz oscillator using a 30¢ transistor or it may be 3000 MHz. It can even be down in the sound wave region of things.

Microwaves are very similar to sound waves, oddly enough. The wavelengths are about the same, in case you never stopped to think about it. Thus acoustical devices may often have their microwave counterparts, and vice versa.

The other day, while doing some work on a little scheme of mine called "Radeye," a sort of microwave eye for seeing through fog, I suddenly got to wondering if the same basic idea might not be adapted to the sound spectrum and applied as an underwater sonic eye or "Soneye."

The sound waves and techniques used to see underwater in this new system show striking similarities in "antenna" (lens) size, beamwidths, refractive index, gains, signal frequencies and amplifiers, and in the viewer, to the electromagnetic waves and methods used in microwave viewing systems.

It is considered that many amateurs will be interested in the basic electronics common to both these fields of scientific endeavor, related as they are to amateur radio.

Basic Soneye

In order to actually see underwater by sound waves you need a source of sound waves in the water, a receiver for these waves, preferably using an underwater lens which will produce an image, and a transducer, sound waves to light waves, so the pilot or scuba-diver can see where he is going and what he is doing, even in dark or muddy water.

Sound waves useful in Soneye run from very short waves of less than an inch and frequencies up near a megahertz for close-in work a few feet away, to much longer waves going down to as low as the audible range for underwater vision out to a mile or so.

These may be of the following types. Note that each time the word "light" is used it means underwater illumination by sound waves.

1. Beacons, underwater "lighthouses," tail lights, channel markers, anti-collison lights, etc. These sources have their own power and operate completely independent of any receiver. When used, they form a one-way system of direct lighting. CW

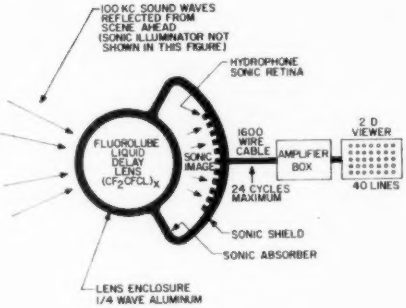

100 KC SOUND WAVES REFLECTED FROM SCENE AHEAD (SONIC ILLUMINATOR NOT SHOWN IN THIS FIGURE)
HYDROPHONE SONIC RETINA
FLUOROLUBE LIQUID DELAY LENS $(CF_2CFCL)_x$
SONIC IMAGE
1600 WIRE CABLE
AMPLIFIER BOX
2 D VIEWER
40 LINES
24 CYCLES MAXIMUM
SONIC SHIELD
SONIC ABSORBER
LENS ENCLOSURE 1/4 WAVE ALUMINUM

Fig. 1. Basic Soneye.

(continuous wave) is used, and no synchronism is needed between source and receiver.

2. Indirect lighting. This type of underwater sound illumination is similar to ball-park floodlighting, or flares as used in battle areas. It is not necessarily near the desired object or scene, nor is it necessarily near the viewer. It is semi two-way. Again, it is CW and no synchronism is needed.

3. Headlight, or flashlight type of underwater sound illumination. These sources are carried by the user and are therefore close to the receiver, as the headlights of a car or a hand-held flashlight. CW may be used, or pulse, if three dimensional vision is required.

The underwater sound is generated by one or more oscillators connected to one or more transducers. A transducer changes electrical waves to soundwaves like a loudspeaker, although generally it is made of ceramic and is in direct sonic contact with the water.

Methods of sonic illumination:

A. In the simplest form one transducer would be used, like a flashlight bulb. It could be broad or narrow beamed.

B. More than one transducer could be used, in which case they would be placed in back of a liquid underwater lens and each transducer would benefit from the full gain of the lens.

C. A large number of transducers could be used in back of a large lens with each transducer again having the full gain of the lens, to project a sharply defined image ahead for special purposes. Large area powerful sonic illumination for searching would be one of these purposes. It is interesting to note that no phase requirement exists with such a powerful illuminator. This is one of the lens features for sonic illumination and lowers the cost and complexity by a considerable amount.

The Underwater Lens

Soneye, being an underwater sound reproduction of the human eye, uses a lens to see with. Again, all mention here of seeing means by the use of sound waves. The only light waves used are between the actual viewer and the pilot's eyes.

A liquid lens is used (see Fig. 1). "Fluorolube," made by the 3M Company, is very useful for this work. It may be enclosed in a thin aluminum sphere which is mounted in "RHO-C," a special type of rubber which matches the acoustical impedance of sea water.

The action of such a lens is similar to that of the human eye or the dielectric lenses used in microwaves. Such action is detailed in Fig. 2, where object A is focused on hydrophone A and object B on hydrophone B, etc., until an image is formed. This is the same process your eyes are using to read these words.

Sound waves traveling through the center of the lens are delayed more than those going through a smaller amount of the special liquid, near the edges. It is the same liquid throughout the lens. This action causes the waves from any single point sound source to be focused at a single detector, or hydrophone.

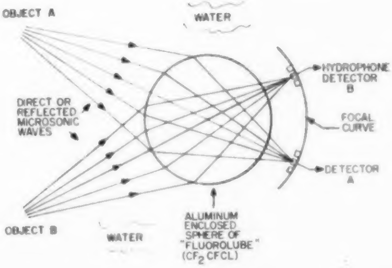

OBJECT A
WATER
HYDROPHONE DETECTOR B
DIRECT OR REFLECTED MICROSONIC WAVES
FOCAL CURVE
DETECTOR A
OBJECT B
WATER
ALUMINUM ENCLOSED SPHERE OF "FLUOROLUBE" (CF_2CFCL)

Fig. 2. Sonic lens action for illumination substitute sonic radiators for detectors.

Power gains of 30 dB and over (one thousand times in power) and sharp beams are obtained by such lenses, as shown in Fig. 3, which details patterns and gains from actual tests underwater.

When a "sound wave retina" of small hydrophones is placed on the focal surface at the rear of the lens, as in Fig. 1, a sound wave image of the scene out front is produced, when such scene is illuminated by sound waves from one or more of the sources detailed earlier.

Note that the placing of the hydrophones on the focal surface is under the control of the designer, and thus no lens corrections are needed.

The maximum angle of view, that is, how much of a scene out front can be viewed without turning the whole lens (or any part of it, and without any sort of phasing or scanning of any kind) is a solid angle or cone of 90°. Thus six lenses can take care of the entire sphere surrounding a submarine.

In all Soneye systems so far, the illuminating lenses are always separate from the viewing lens.

The size of the lens may vary from a pair of 1 in. liquid spheres in a stereo underwater seeing headset system for a scuba-diver, to a very large one, like 10 or 20 ft in diameter, for use on a large and fast submarine.

The Microsoundwave Viewing System

Fig. 1 shows the major features of the viewing portion of the Soneye system. The lens action described earlier details how the reflected microsoundwave energy arrives at each individual hydrophone. In the mosaic of hydrophones (retina) placed at the rear of the lens, each unit is positioned at the best focal point while operating underwater.

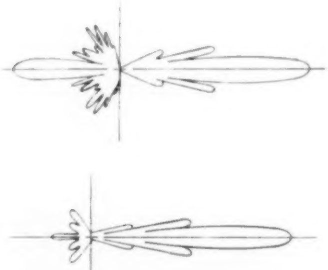


Fig. 3. Beaming effect of Soneye. Actual gain patterns.

Each hydrophone is followed by an amplifier operating at the microsoundwave frequency. At these frequencies, which may be from 5 kHz up to 1 MHz, according to distance and/or picture and using needs, it is mainly a matter of low noise stage first, followed by gain stages suitably arranged for dynamic range, demodulators, modulation frequency filter-amplifiers, and more demodulators. In general, the modulating frequency may be quite low, the bandwidth needed not exceeding 24 Hz for normal operator viewing.

Fascinating possibilities are opening today for enclosing very large numbers of very small amplifiers in small containers. Among components advancing rapidly in this direction are Microtabs, microcoils, and IC's. Some very fascinating little transistors are made by G.E. under the name Microtabs which are really small, less than .060 in. thick. They work just the same as their big brothers and do nicely up to 1000 MHz.

The Piconics Co., North Billerica, Mass., make signal amplifier coils which are a good match for the Microtabs in size, a tuneable core unit also being less than .060 in. thick. Along with tenth-watt resistors and "Slim-cap" capacitors, I have homebrewed good working printed circuit amplifiers the size of postage stamps with a total overall thickness less than 1/10 in. Using these kinds of discrete components a skilled amateur homebrewer can make complete amplifiers between ¼ and 1 in. cubic volume.

Integrated circuits and Large Scale Integration present even greater possibilities, although the manufacturers of these devices still shy away from claims of flat packs with 200 to 300 transistors for use with *tuned circuits*! However, there are possibilities even today of making up quite small units. Good flat packs, ¼ in. long, 1/8 in. wide, and 1/20 in. thick and real small coils (they still cost dollars in small quantity) can be made up into amplifiers in the near future with some 100 to the cubic inch. A camera case size box then begins to carry quite a number of picture elements, like perhaps ten thousand, capable of a 100 line picture.

The Viewer

The basic component of this device at the moment is the "microlight," one for every hydrophone-amplifier chain, arranged in a mosaic viewer as in Fig. 1. I have some of these tiny bulbs operating here, and they are only .012 in. (12 mils) thick. Leaving a little room for cement or other, you could put 50 lines of 50 in each line for a total of 2500 picture elements in a square inch, thus making practical today the 2D stero-viewer-headset. Fig. 4 shows how basic a good light bulb amplifier can get.

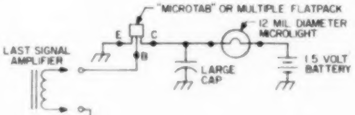


Fig. 4. Basic light amplifier circuit.

Also, nothing prevents a forward looking bulb manufacturer from putting several thousand filaments in one evacuated bulb!

This might be an excellent application for the newly developed light emitting diodes (LEM's), which are tiny enough to be considered for near-future television screens. Different color diodes could be used to indicate depth in viewing with blue for most distant objects, green for nearby and red for close. The diver or operator would soon get used to a system such as this and "see" underwater automatically. Diodes would have the virtue of using far less power than even the tiniest of filament lights.

By proper handling of the control characteristics of the signal frequency and modulation amplifiers, a large dynamic range can be achieved with this circuit.

A 3D viewer can also be made quite small. Many forms of this type of viewer are of course possible, including the beam-splitter type which projects the viewed scene onto a semi-transparent glass in front of the pilot's eyes. This allows the light waves from the actual scene out front to be used by his eyes, when and if a visual image does break through the water ahead, presumably at some short distance.

Note the fail-safe feature of having many separate complete receivers. 10% can be out of order, and the main scene will still be present for the pilot.

Fiber-optics are also well suited to bring this type of image to places other than where the light bulb viewer actually is.

2D Ranging

The simplified version of Soneye, like the human eye, uses only two dimensions, elevation and azimuth, to use military type terms. Range, or depth perception, is supplied by a host of optical and mental tricks, among which may be cited stereo, decreasing size with increasing distance, foreknowledge of the size of the object, displacement against a background or other stationery scenes, ability of the human eyes to point together at a given distance, and other methods.

The 2D stereo Soneye is arranged to employ most of these factors and is considered to have some 80 to 90 percent of the ability of the human eye for the purpose of depth perception. This percentage figure is of course dependent on the number of picture elements used, which becomes mainly a matter of cost.

Enhanced depth perception is easy with Soneye, the two lenses have only to be separated by a distance greater than the average 2¾ in. between human eyes. This is already done in certain aircraft cameras looking at the ground, where a one story building can be made to stand up like a four story one.

It is hoped that my ideas on the Soneye will start some neurones oscillating, steaming up the synapses with visions of light emitting diode matrixes and the millions of dollars to be made therefrom. Please don't forget to send an old man a little royalty check now and then from the profits. Okay?

. . .K1CLL■

Frank C. Jones W6AJF
850 Donner Avenue
Sonoma CA 95476

RF Power Measurement with Hot Carrier Diodes

Two rf wattmeters are shown here, one with a range of 25 mW to 10W and the other covering the range of 5 to 300W. Both are useful from low radio frequencies on up through 450 MHz.

The low-power version (Fig. 1) makes use of a 20W Sierra dummy antenna built into the meter case, though the metering circuit only goes up to 10W. If the maximum is to be 20W, the reference meter reading could be about 45 μA instead of 30. The minimum power reading would be doubled. In this wattmeter, the power range potentiometer is calibrated and only a reference line on the meter is used when making rf measurements. The dummy 50Ω antenna resistor is rated up to 1000 MHz so is excellent from 450 MHz down.

The range potentiometer had an audio (nonlinear) taper. By connecting the "high" resistance end to the diode, the watt range scale is spread out quite well in the 0.1–10W range. The hot carrier diode, an HP 2900, has a 10 PIV rating, which means that the rms rf voltage across it should be less than 3V for safe operation. At 10W of rf power, the rms voltage would be a little over 22V, which means a voltage divider is needed to keep the applied diode voltage down to about 2V. An HP 2800 diode with a 75 PIV rating would be more desirable, especially if the meter was to be calibrated for 20W maximum. This diode is about $1 and has a little higher capacitance, which would require a different shunt capacitance across parts of the resistor divider to make the device work with the same power range calibration.

The divider should use ½W resistors of the carbon or metal film type, since these units are part of the rf circuit. It is better to use three ½W 300Ω resistors in the string rather than a single 900Ω 2W resistor; this is because the rf resistance characteristic is usually better in ¼ or ½W types in certain ranges of resistance. Every resistor has some inductance and shunt capacitance which becomes part of the voltage divider. The diode shunt capacitance is in parallel with that of the 110Ω ¼W resistor in Fig. 1. However, nearly any combination of resistor sizes can be equalized within 10 to 20% over the desired frequency range. This divider is across the 50Ω dummy antenna, so should not shunt the value down to less than 49 or 48Ω. This divider

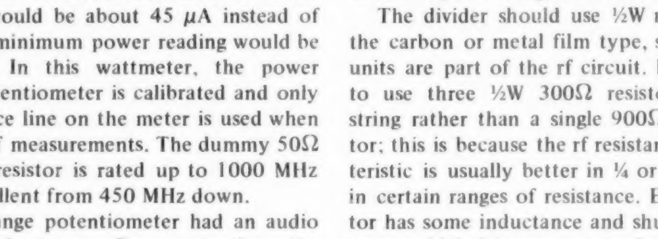
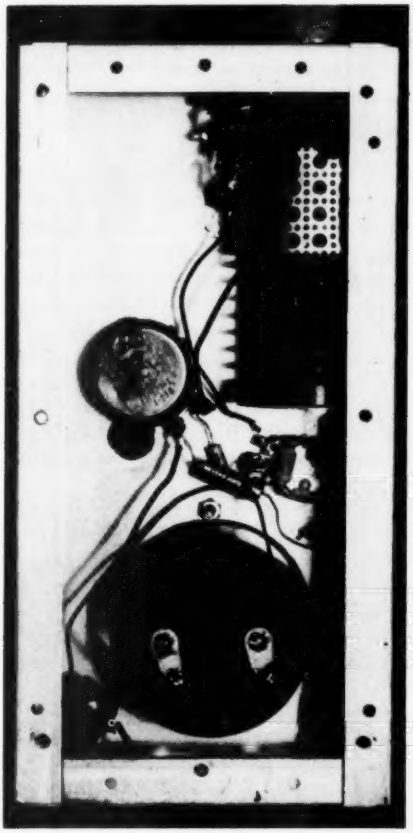
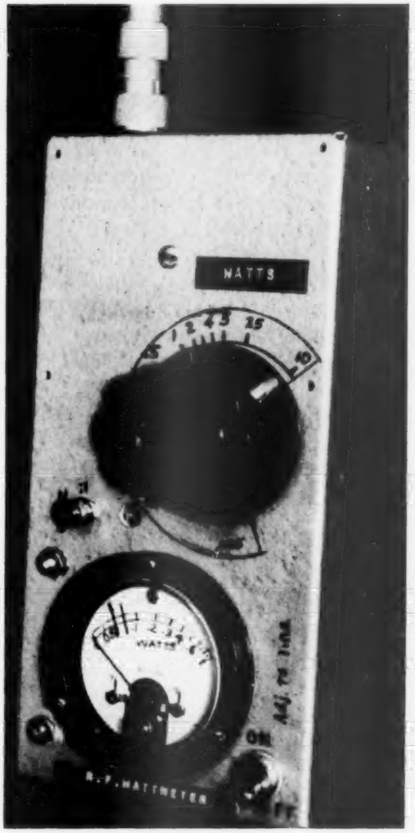


Fig. 1. .025 to 10W RF wattmeter.



Bottom view of 10W unit with the rf dummy antenna clamped in one corner.



Top view of low powered rf wattmeter covering .025 to 10W. Built into a 8x4x2 chassis with wire screen bottom plate for ventilation.

has to dissipate a little rf power also. Its total resistance should be at least 20 times as high as the dummy antenna load resistor.

The values shown in Fig. 1 are just about the minimum that should be used. Too high values makes it more difficult to extend the frequency range to the upper end, though it can be done, as was discovered in the higher-powered wattmeter of Fig. 2.

All diodes are poor rectifiers at applied rf voltages below their forward bias values of 300–700 mV (peak). By using a forward dc bias voltage to make the diode conduct at least 5 or 10 mA, the detection sensitivity is increased as much as 5 or 10 times. This requires a small battery, a couple of fixed-value resistors, and an adjustable pot to balance this current out of the meter when measuring rf powers below 100 mV. If the power range is limited to a minimum of ¼ or ½W , no bias circuit is needed in this 10W instrument. The range scale in either case has to be hand calibrated.

A low-powered radio transmitter or exciter can be used as a 10W power source when calibrating the power range pot scale. The transmitter can use stage detuning to reduce power outputs down to the lower values needed. Many swr meters have watts of power calibration and one of these can be put in the coax line to the rf wattmeter for calibration service. A more accurate calibration can be made by comparing the power readings against some reliable commercial rf wattmeter within its frequency range and calibration charts. This scheme is usually necessary for checking the calibration at VHF or UHF. Another method is to use an accurate rf voltmeter across the dummy antenna connection to ground and read the power values in watts = E^2/R. For example, 5V (rms) squared is 25; and divided by 50Ω is equal to 500 mW.

The Sierra 50Ω dummy antenna has no connection available at the high end of the resistor, which terminates in a type N fitting. The metering circuit has to connect to this point as close as possible by getting into the inner conductor of a coax fitting, or by drilling a 3/8 or ½ in. hole through the shell of the dummy antenna close to the rf fitting end. This can be done and the first 300Ω resistor in the voltage divider soldered to the inner connection to the large 50Ω resistor. A long 1/8 in. diameter soldering iron tip is needed. The divider resistors, diode, and four .001 μF stud-mounted bypass capacitors were all mounted around this large hole in tapped 6-32 holes for the four capacitors. Larger values of bypass capacitors can be shunted across these 0.001 μF values to ground to extend the frequency range down to low rf or even af values. For example, a .02 μF capacitor shunt would allow operation to 2 MHz. A miniature 50 or 100 μF electrolytic shunt would function at audio frequencies down to 300 Hz. The diode must have a low-impedance path to ground over the desired frequency range to function as a peak rectifier and get as much dc output voltage as possible for the meter circuit. The microammeter in series with a variable range resistor is simply a dc voltmeter. The diode rectifier converts rf voltage to dc, so the diode should be equally efficient over the whole rf range.

The 5–300W unit was built to use with a large dummy antenna rated up to 500 MHz, which is a massive unit external to the box shown in the photographs. Quite a bit of rebuilding went into this device to make one calibration of the range potentiometer fit all frequencies from 450 to 2 MHz. The input and output coax fittings had to be finally mounted so the inner conductor tips could be soldered together and the resistor divider connected to this point. The latter consisted of two 4300Ω 2W carbon resistors and a 68Ω 1W resistor in series to a copper sheet inside of the aluminum box.

The watt range variable resistor was a 500 kΩ linear potentiometer which was limited to a lower value by shunting it from the moving arm to the diode connection end with a 220 kΩ resistor. This gave a maximum power reading of 300W when the reference line was drawn on the meter face at 12 μA. The import, low priced, 0–30 μA meter had a large meter scale. A smaller 0–50 μA meter would have been usable, since the meter is used only as a reference. The range pot knob is adjusted when rf power is applied to run the meter reading up to the line drawn on the meter scale face.

The circuit shown in Fig. 2 was equalized to within about 15% error over the range of 2 to 450 MHz by shunting a 5 pF capacitor across the 68Ω resistor in the rf divider.

Calibration of this device was made at 144 MHz using a transmitter having up to

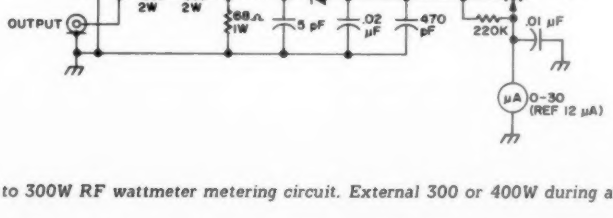


Fig. 2. 5 to 300W RF wattmeter metering circuit. External 300 or 400W during antenna load.

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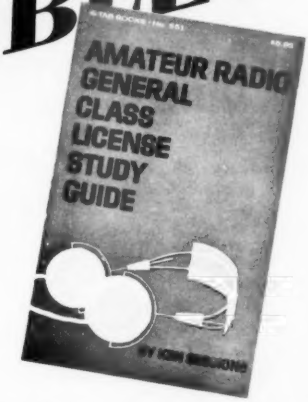

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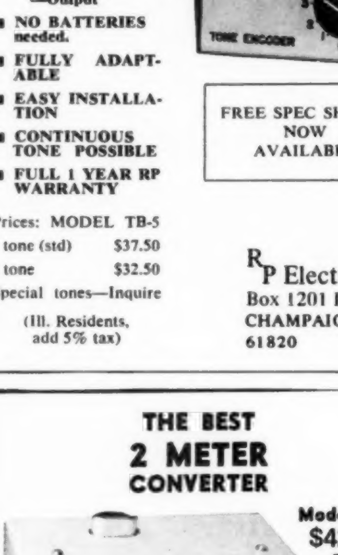

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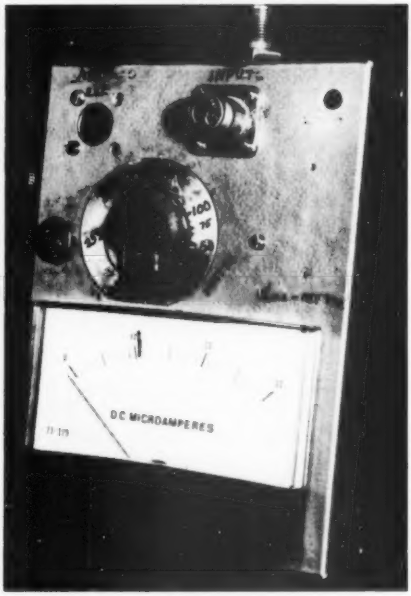

Top view of 5 to 300W metering circuit for use with external high powered dummy antenna.

400W available carrier output. The meterizing unit was connected to a large Bird rf wattmeter at the external fittings of the latter. Several thermocouples had to be used to cover the wide range of power for the calibration. This required reading a chart curve for each Bird wattmeter reading and using correction factors for frequency in order to obtain the actual watts of rf power. Now, the large unit is used without the thermocouples, charts, rf choke, etc. simply as a dummy antenna. The new metering circuit connects directly into the antenna fitting, with a few feet of 50Ω coax over to the transmitters being tested.

This power measuring device can be used in any 50Ω coaxial line to monitor the actual power going toward the antenna. The swr in the line should be low, or near unity, in order for the calibration to be reasonably accurate.

W6AJF

John Schultz W2EEY
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Mystic CT 06355

IC/Photocell Compressor/AGC Unit

The unit described can be used as an audio compressor in a transmitter or as an audio agc unit in a receiver. The use of a photocell allows particularly easy adaptation of the unit to an existing piece of equipment.

One problem with many compressors or audio agc units is that they cannot be conveniently built into an existing transmitter or receiver, since the amplifier and control sections of the unit cannot be readily separated. Consequently, such units are usually placed in separate enclosures and mounted in the microphone lead to a transmitter or in the loudspeaker or headset audio output leads of a receiver.

Most such conventional compressor/audio agc circuits use transistor stages for both amplification and control functions. It is difficult to separate the stages physically unless additional coupling stages are added, so that the amplifying and control functions can each be located where each can function best and where power and space in a transmitter or receiver are most readily available (see Fig. 1A).

The IC/photocell unit to be described overcomes most of these limitations. The amplifying and control functions can be separated as desired (Fig. 1B) through the isolation medium of a photocell-lamp module. Although described as an audio compressor/agc unit, the photocell-lamp module allows control to be achieved of an rf stage as well through its biasing network. Only the derivation of the control function is restricted to an audio frequency point in a receiver or transmitter, since the IC amplifier used operates at audio frequencies. In an rf amplifier, an rf actuated and rf control compressor could be achieved. Although it has not yet been tried, it would seem that this latter approach might produce a highly effective SSB rf level compressor without the need for two sideband filters as is required with

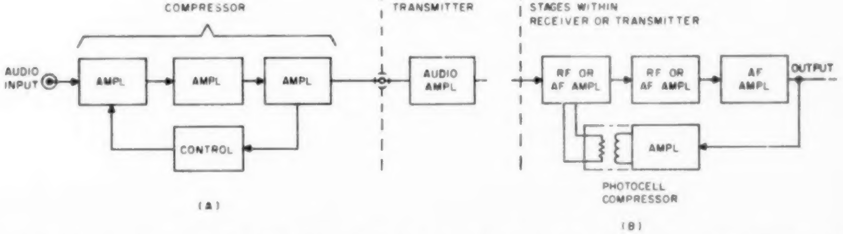

Fig. 1. Amplifier stages of usual compressor are in series with transmitter or audio chain (A). Photocell compressor (B) works parallel to controlled stages and the photocell module provides both noise isolation from compressor amplifier and feedback isolation between controlled amplifier stages.

SSB rf level dipping circuits.

Besides separation of the amplifying and control stages, the use of a photocell-lamp module also overcomes the noise build-up problem associated with conventional audio compressors. With such compressors, noise build-up occurs at the output of the compressor during speech pauses because, without speech input, the gain of the compressor rises to a high value and amplifies the self-noise of the first stage in the compressor to a high value. Choosing a long time constant in the gain control stage of the compressor will act to suppress such noise build-up, but one is quickly limited as to how far this approach can be used. If the time constant is made too long, low level speech inputs to the compressor following a higher intensity input will not be amplified sufficiently. Since the amplifier stages of the photocell compressor need not be in series with the audio chain in a receiver or transmitter, its noise output is not reflected in the controlled stages. Also, the thermal-photoelectric interface within the photocell-lamp module prevents the coupling of noise or spurious frequencies from the audio amplifier of the compressor. In fact, the audio amplifier portion of the photocell compressor can be rather simple and produce considerable distortion without affecting the units' performance. The only real requirement is that it produce a power output sufficient to drive the photocell module which is directly proportional to the audio level at the sampling point within a receiver or transmitter.

The use of a photocell also provides feedback isolation between the sampling point and the controlled point in a receiver or transmitter. Since no direct electrical connection is involved between the two points (except for the minor capacitance between the lamp and photocell in the module), one does not have to worry that the feedback loop has a time constant greater than the lowest frequency at which the gain of the controlled stages is greater than unity – a criterion for stability in an electrically coupled compressor feedback loop.

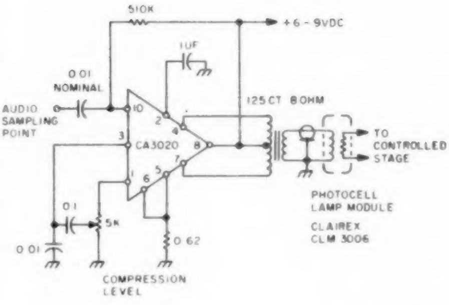

Fig. 2. Photocell compressor/agc circuit schematic. Voltage rating of capacitor to terminal 10 must be chosen to protect unit from voltage found at sampling point. DC operating voltage need not be supplied from an extremely well filtered source since audio quality of amplifier is not significant.

Circuit Description

Figure 2 shows the schematic diagram of the compressor/agc unit. The integrated circuit used is an RCA CA3020 which can produce about 500 mW output. Various other audio amplifier integrated circuits can be used such as the GE PA234 and also various surplus operational amplifiers can be used. A module type audio amplifier or discrete stage transistor amplifier can also be used. The prime criterion is that the amplifier produce enough power output to properly drive the photocell – from 150 to 250 mW.

The external components used with the IC are chosen primarily to give sufficient power output rather than maximum undistorted power output, as would be the case if the IC were used for strictly audio reproduction. A 5 kΩ potentiometer between stages in the IC acts as a compressor level control. No input potentiometer is used due to the fact that even if some slight overdrive of the input should occur, it would not be significant in this application. The output transformer secondary drives the lamp of the photocell module. The module may be placed any reasonable distance from the amplifier and connected to it by shielded audio cable. It is not necessary to rectify the output of the

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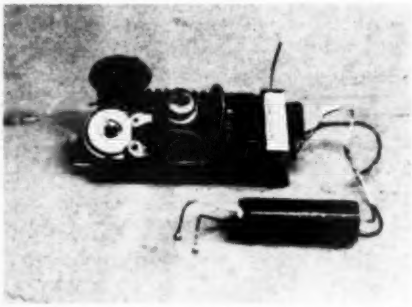
amplifier, since the thermal inertia of the lamp in the photocell module will "wash out" instantaneous level variations. The photocell module itself can be any one of a number of Clairex or General Electric units which sell for $3–$4. The Clairex CLM3006 unit works well for a general variety of applications. Its lamp drive requirements are 6 volts at 40 mA maximum, and the resistive element in it will vary from a value of over 100 kΩ when the lamp is not excited to about 200Ω when the lamp is fully driven. The photocell module itself also provides a sort of automatic delay action, since the change in resistance is not linear with lamp drive but generally is slower at low lamp drive levels. Thus, depending upon how the resistive element is placed in a circuit, compression action increases with higher signal levels.



Assembly of compressor/agc units on Vectorboard. Photocell unit is shown next to output transformer. Compressor level pot is at other end of Vectorboard, and IC unit is in middle with circuit components grouped around it.

Construction

The photograph shows how a typical photocell audio amplifier driver circuit can be assembled on a piece of Vectorboard. The photocell module would, of course, be located remotely from the amplifier circuit. A fin-type heat dissipation device should be used on the IC, depending upon the manufacturer's recommendation for the unit used. A PC board type trim potentiometer, located to the right of the IC, acts as the compression level control. Since the control does not have to be readjusted normally after initial setup, it can be left as a component on the Vectorboard. If it is desired to have some means to continuously control the compression level as well as turn off the compression action, the potentiometer – brought out as a panel control – will perform both functions. The output transformer on the left is a conventional miniature transistor type with an 8–16Ω secondary.

Placement

The objective in placing the resistive element of the photocell module in a receiver or transmitter circuit is to make maximum use of its wide resistance change. At the same time, the resistive element cannot be used such that it must dissipate over 1/10 watt. One possible placement for the resistive element is shown in Fig. 3A, where it is used as part of a voltage divider network in a fairly high impedance circuit. In some units the microphone input itself or the interstage coupling point after the first audio amplifier might be used. Theoretically, the large resistance range change of the photocell resistive unit could produce voltage output changes in a high impedance divider network of over 40 dB. Another possible placement of the resistive element which also prevents dc from flowing through it is shown in Fig. 3B. As the photocell module is driven harder, the resistive element increasingly shorts to ground the audio bypass capacitor. Such a capacitor would be placed between audio stages in a receiver or transmitter to shunt the audio signal to ground as compressor action takes place. There are various other placements possible for the resistive element, such as in the bias line to the stages it is desired to control or even as a shunt element across a low level audio transformer. The placement that will achieve the best control can be quickly determined by experiment.

The sampling point for the compressor's audio amplifier input is usually taken at some interstage point towards the high level end of the audio chain in a unit. The sampling connection should have no effect

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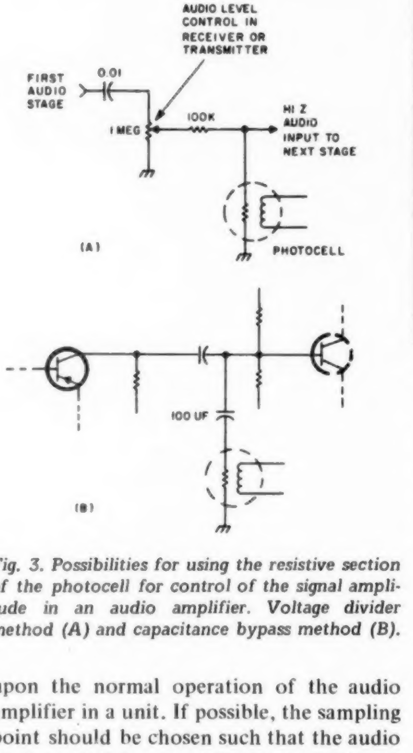
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(A)
PHOTOCELL
100 UF
(B)

Fig. 3. Possibilities for using the resistive section of the photocell for control of the signal amplitude in an audio amplifier. Voltage divider method (A) and capacitance bypass method (B).

upon the normal operation of the audio amplifier in a unit. If possible, the sampling point should be chosen such that the audio level control in a unit is located earlier in the audio chain. The controlled point can be either before or after the audio level control.

Operation

With the compressor control initially set for minimum gain, the audio level control in a unit is set for the highest desired audio level. The compressor control is then advanced until the audio level decreases significantly. The audio level control is again advanced until the desired output level is achieved. Basically, the circuit should then be set, although one will have to initially adjust back and forth between the audio level and compressor controls until the optimum compression range is obtained.

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Summary

The photocell module is a very versatile unit for compressor and agc control circuits. Many more circuits are possible with it than the one illustrated here. For instance, if one wanted to use a varying dc voltage as the control source for the module this can be done by using a dc amplifier and direct output coupling in place of the audio IC amplifier shown. With some low power vacuum tube circuits it is also possible to place the lamp of the photocell module in series with a cathode resistor and achieve direct control without any amplifier at all.

. . .W2EEY■

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So along comes a product on the consumer market called On-Guard(tm), a self-defense invention in a tube. At first glance, it looks like a felt marker pen, being about 3½ in. long and ½ in. in diameter. It's filled with a chemical which is absolutely harmless (not Mace or teargas) but, however, causes the following temporary effects: stinging and burning of the nose, throat and eyes; nausea; after burning the throat, it produces choking and coughing, and gives the recipient a weak-in-the-knees feeling. I can certify the effects, as I took a small whiff of the stuff! (My last, by the way!)

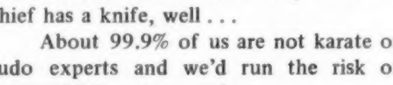
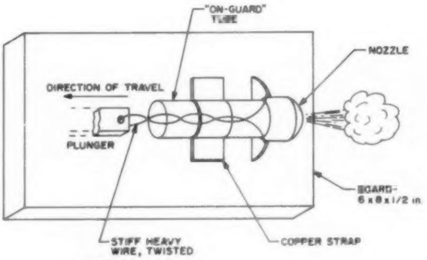


Fig. 1. Schematic of theftstopper. S1 is your car's courtesy light switch; S2 is a toggle; K1 is a delay relay (10 sec.); K2 = 12V solenoid, heavy-duty; V1 = On-Guard chemical spray tube.



MOUNT THE ASSEMBLY UNDER THE DASH, FACING THE SEAT

Fig. 2. Detail of solenoid plunger and tube.

One whiff of the mist and your nose tells you to go the opposite way . . . fast! Stealing a transceiver, microphone, or anything in the car will be the farthest thing in the thief's mind. The chemical vapor will stay in your car a long time.

To make the automatic theft stopper, you need a 10-second delay relay (12V), a 12V heavy-duty solenoid, a single-pole toggle switch, an On-Guard, and a 6x8x½ in. board. A sample circuit is shown below. The On-Guard can be bought for $2.98 each, postpaid. On-Guard cannot be sold to residents of California, New York, Wisconsin, or Michigan. They can be sent by mail to all others, however.

I might add that the U.S. Post Office has made a decision to issue them to all letter carriers, to protect against biting dogs and whatever.

. . .K4EPI■

Mike Doolin WB8CDU
460 W. Napier
Benton Harbor MI 49022

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A MARKETING MAN'S APPROACH TO HAM RADIO

The growth of ham radio in the last 5–10 years has been anything but encouraging. The numbers tell the story loud and clear: While population, leisure time and disposable income have all increased, ham radio has remained stagnant. Unless we reverse this alarming trend, we will join the dinosaur in Nature's list of species that no longer exist.

Why we have let this situation develop is a question I will leave to the psychiatrists in our ranks to discuss. What can be done about it is something else again. The cure for our lack of growth can be summed up in one word: marketing.

Marketing: that art/science that deals with getting buyers together with products or services. I believe that by using some basic marketing techniques we can greatly increase our growth. The key to this requires some rethinking on our parts. We must stop considering ham radio as a hobby/service. . .and start thinking of it as a product to be sold. And it can be sold. . .it can be packaged, presented, and promoted just like new cars, breakfast cereal, or transceivers. But first we must become accustomed to handling and thinking about ham radio as a product. Some of the basic marketing techniques that will allow us to do this are discussed below.

Buyers & Benefits: For any product to exist for any length of time, someone must be willing to buy it. And buyers do not buy products – *they buy the benefits those products supply.* Think about it. You buy a new car not just for the sake of having a new car, but for the benefits that car will bring. . .improved styling and performance, comments from friends, a feeling of importance or difference at having a new car when others don't. Buyers buy benefits, not products.

Advertising: To have a product full of benefits that people are anxious to buy is common. To have a product like that, and then believe that buyers will flock to your door through divine intervention is stupidity. . .yet that is exactly what we have been guilty of for many years. It is not enough to have a good product. You must tell people that you have it, and tell them in such a way that the benefits of your particular product become clearly superior to supposedly similar benefits from other products. This is the basic idea of advertising and it is a lesson we must learn if we are to survive. Yet we have acted as if we were actively trying to keep the existence of ham radio a secret. Probably we were not, but we couldn't have done a better job. Few people even know we exist, and those who do tend to dismiss us as a bunch of nuts playing with toys. Not only must we let the world at large know about ham radio and what it can do, but we must do it in a way that will encourage others to join us.

So much for basic marketing. Let's return now to discuss these points in greater detail; first, the benefits, then the buyers who would be interested in these benefits, and lastly the area of advertising.

Benefits.

The benefits of ham radio are myriad, but some of the more obvious are detailed below. Indeed, many of these are common to all successful products.

Ham Radio Is Different. A product which is different has instant appeal. Volkswagens are radically different from their American counterparts in many respects, and these differences have helped make the VW the largest selling imported car in the U.S. It's ugly; its gas mileage legendary; its service network vast and well organized. A list of the Bug's differences would be long, but the assumption to be made is valid: differences help sell products.

Ham radio has these differences in abundance. It is really a one-of-a-kind product. It offers instant communications around the world, across the street. It doesn't depend on weather to be enjoyed, like many sports. It is relatively inexpensive to get into, as opposed to most other types of recreation. And it is the fastest way known to meet new friends and become exposed to wide variety of new ideas. Amateur radio is different from everything else you can think of. These differences are benefits to potential buyers . . .use them!

Ham Radio Is Educational. Today's largest, fastest-growing market is education. People are discovering that to improve their world they must first understand it. . .and they are trying to do just that in record numbers. Classrooms are overflowing 18 hours a day. . .home study courses and books are the hottest thing going . . . long-forgotten arts and crafts have suddenly been rediscovered.

The key to this phenomenon is self-improvement . . . and self-improvement is an FCC-imposed requirement. It is a benefit. We live in an electronic world, and it can only become more so. Remember that when you go out to sell ham radio. It is the only hobby around that not only offers an enjoyable diversion, but an opportunity to better understand our electronic environment.

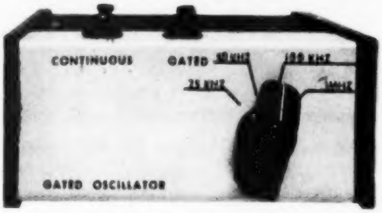
Ham Radio Has Snob Appeal. While that may be a poor choice of words, it is nonetheless quite true. People buy Cadillacs and Rolls-Royces not because these cars offer much more in the way of basic benefit (transportation), but because this type of vehicle has snob appeal. These cars scream out that their owners have achieved some measure of financial success.

We all desire this sort of recognition . . . we all need to be unique in some way . . . and ham radio offers the chance for uniqueness. It sets us apart from the masses . . . that ticket and rig endow us with an extra measure of respect whenever the other guy is made aware of the situation. Use this benefit in small doses, however. No one likes to be reminded that in some respect he is not as good as you. Snob appeal works for many other products and it can work for us, too.

Ham Radio Is A Challenge. In a world full of pushbutton, computerized conveniences, people still like to tackle something with just their hands and minds, and overcome it. When confronted by an appealing challenge, most people take it up, for they know that successful completion will make them feel quite good.

The challenge in ham radio is obvious. Unlike another radio service which can be entered with an examless application, all the money in the world won't buy you a

GATED CALIBRATED MARKER GENERATOR



The K-OSC.-G1 is a gated generator on and off 3 times per second making it easily recognized on todays crowded bands. Frequency – 1 MHZ, 100 KHZ, 50 KHZ, 25 KHZ. Accuracy – High Precision 1 MHZ xtal. .001%. Gate time – 3 Pulse per second. Harmonics – up to 200 MHZ. Output – Square wave 3.5 PP. Electrical Description – All solid state, printed circuit on 1/16" glass board. ICs 2 gates, 3 dividers, and 1 transistor. A ceramic trimmer allows zero-beating WWV. Physical description – The K-OSC.-G1 Generators are small, structurally rigid yet light-weight instruments which are designed for portability. The instrument is enclosed in a 3 color vinyl covered metal & plastic cabinet. Dimensions are 2 3/8" x 5 1/8" x 6".

K-OSC-G1 Wired and Calibrated $45.50
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don't overlook the kids who would benefit most from an involvement in ham radio. These are the ones in orphanages . . . in the ghettos . . . on probation and in correctional institutions. There are tens of thousands of these kids who've gotten off to a bad start in life. Ham radio could change their attitude toward the world and other people, and make them useful, productive, creative citizens. These kids need ham radio and we need them. Think about it.

Organizing an efficient program to recruit large numbers of kids would be a costly, time-consuming task. Worthwhile, but still beyond the capabilities of most of us. There is an area where we can all help, though – and that is on a one-to-one basis. Just find a kid who might be interested and talk to him about it. When was the last time you invited the kid down the street into your shack? If you haven't tried just this simple gesture, please do. You can't imagine the wonder in a kid's eyes when he discovers that he can actually talk to someone in another country. Try it . . . you'll be amazed at the results you can get with just a friendly invitation and a short QSO.

The first major group mentioned above – those already interested in communications or electronics – are the second major group containing potential hams.

CBers come to mind immediately, and it's a giant-sized market that we've done little but aggravate. Most CBers are, believe it or not, real human beings, and they respond to the same kind of treatment you and I like: friendliness, courtesy, etc. Attend your local CB club's meetings, get to know the members. Many of them are just frustrated hams who have been turned off by a past failure or the continuing war of CB vs ham radio – a war kept alive by a few idiots on both sides. Give the CBers an honest try . . . you may be surprised at the favorable response you get.

In this same category fall the experimenters and hobbyists . . . the high school kids just beginning to fool around with electronics . . . the guys who build Heathkits. Both types are prospects. If you know

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ham ticket. It takes study and determination . . . you have to earn it. Explain the challenge in ham radio to your prospective customer without making it sound so complex that he loses interest. Confront him with the challenge head-on . . . and watch it work.

The Market

So much for some of the benefits of ham radio. Let's turn now to finding our market.

Most people, whether they realize it or not, could derive some benefit or satisfaction from becoming a ham. Granting this to be true, the question of finding the market then resolves down to one of locating groups where we would be most likely to recruit the greatest number of hams at the lowest cost in time and money.

The two groups that we should be aiming at are those that already have an interest in some form of electronics, and people who have a natural curiosity about the world around them. Let's take the second group first.

Children. Natural curiosity. The two are practically synonymous. Kids are the most important, most readily accessible single group of potential buyers we have, and they've been studiously ignored for far too long. Kids are the future of ham radio and we should concentrate our efforts on them.

Younger grammar school children are probably too young to get really involved, but that shouldn't preclude at least letting them know that we exist. An impression made on a seven- or eight-year-old now will eventually bear fruit in the form of a green but enthusiastic Novice five to ten years hence.

High school and older grammar school kids are in the market right now . . . we don't have to wait to see if our sales pitch pays off. Get permission to demonstrate your rig in school assemblies . . . invite the paper boy in to see the shack . . . ask the neighbor kids if they'd like to talk to someone across the country, around the world. Volunteer your services as a radio merit badge counselor for your local boy scout troop. The possibilities are endless.

Most groups of kids are obvious, but

any, invite them to your shack or club meeting.

So far we have touched on benefits and buyers. The last area, one that I am particularly familiar with, is advertising. With the sole exception of their recent movie effort (which is quite good), our national organization has done nothing to promote the growth of ham radio, so it must be done by us, as clubs and individuals. If you would like to see ARRL do the job, I suggest that if they were suddenly deluged by 100,000 or so QSL cards requesting them to embark on a national ad campaign, they could do little but start one. Lacking a national campaign as we do, however, we must concentrate on things that can work for us on a local level. Here are just a few ideas that have worked for me or for clubs. Most are merely attention-getters. The balance of the selling process is up to you; but once you have the interest, the final sale should be relatively easy.

Call Letter Plates. Maybe you never considered your call plates as advertising, but they most definitely are. They tell everyone that you are someone special . . . and they generate questions. They are available in most states upon proof of license, and although they may cost a slight amount more, in many states they allow you to license your car by mail, instead of having to stand in endless lines. That alone is enough to prove their worth to me. If you've never tried call plates, check into them.

Conspicuous Stations. Under this heading I would lump everything from 200 ft orange towers to complete stations set up in the living room. Let your imagination run wild. Put your call letters on your mailbox, your business cards, and personal stationery. Post your DXCC, WAS awards, and QSL cards over the dining room table . . .leave your Heathkit assembly manuals on the same table with Time, Life, and National Geographic. Put copies of 73 in the bathroom, where you have a captive audience. Make lamps out of old vacuum variables and finals that have gone to their reward. Pick your teeth with a resistor lead . . .light your cigarette with a hot soldering iron. . .carry an FM pocket transceiver around with you. Do something that will cause questions.

Portable Operation. For those of you who are camping, hunting, or fishing nuts and have a sympathetic spouse, it is unforgivable if you don't take along a rig on your outings. When I go camping with my family on weekends, the first items to be added to the camper are an HP-23 supply and a portable 20m dipole. When I set up my station in a campsite, I never fail to draw a crowd . . . which of course is exactly what I want to do. How many new hams have I generated? I don't know, but at the very least there are a few hundred more people out there who know we exist. Portable operation is a form of advertising that is both easy and fun . . . try it.

Group Demonstrations. You would probably be amazed to learn how desperate most schools are to find good, educational programs for assemblies. Check in with your local school system to see if they can use you and your rig; the odds are that they can. Other groups might like you, too: public service groups like the Lions or C of C, Boy Scouts, church groups, ladies garden clubs. Any group is fair game. You'll be surprised at how many invitations you and your rig will get to perform . . . and spread the word about ham radio.

Public Service Work. In many areas hams provide emergency and public service communications, crowd-control assistance, etc. – and never bother to capitalize on their efforts. Incredible! The very minimum you should have is large signs for your tables and cars, proclaiming who you are and what you're doing. If your club does *anything* in the way of public service, you are missing some giant-sized chunks of free publicity.

Publicity. If your club doesn't have a publicity chairman, it should. One good man in this position can contribute more toward increasing your membership than the rest of the club combined. Most hometown newspapers are only too happy to run news releases detailing some sort of public service work, for free. *Any time* your club has a function, whether just another monthly meeting or a major event involving the safety of other people, get it to the newspapers. The form doesn't matter – it's content that counts. The city-desk man is going to rewrite it anyway. If your club does anything . . . if one of your members in his capacity as a ham does anything, get it to the newspapers.

Radio and TV time can be had too. Many stations have hams on the staff, and a more sympathetic contact would be hard to find. Talk to them . . . find out what they consider to be newsworthy. Some stations will run free announcements about code and thoery classes about to start, participation at local events, etc.

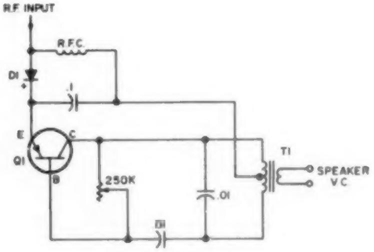
Field Day. Does FD bring to mind visions of a half-drunk group of nuts running around putting things up in the air and shouting unintelligible remarks into a PTT mike? Granted, most field days are run for the gratification of the members involved . . . but don't you think we could find time to include interested visitors in our plans? Sure, it might mean we'd have to stay somewhat sober, bury our Marine Corps vernacular and at least appear quasi-human. But think of the potential! A field day put on primarily to introduce strangers to the world of ham radio might not be a smashing success in the "points earned" category, but it would certainly be one in the final tally of membership figures.

Code & Theory Classes. Any club or group running these classes should make sure that they have an ample amount of publicity to back them up. Tell the papers . . . tell the local radio & TV stations . . . post notices in the schools, laundromats, pizza shops – anywhere that people gather. You'll be amazed at the response you'll get . . . and the new Novices.

In this article I've tried to show how basic marketing techniques can successfully be applied to ham radio, with the purpose of bringing in the new members we so desperately need. The alternative to not promoting our hobby/service is not pleasant. We need new members badly, and treating ham radio like any other product in the marketplace is the only way to get them.

...WB8CDU■

Yet Another Code Monitor



The code monitors in the February 1967 73 must have been a simple answer to many CW men with a monitoring problem. Here's a monitor which works with *any* transmitter, regardless of how it is keyed. All the parts, except the 250k pot, can be found in an old transistor radio and *any* good PNP transistor will work okay. If you have an NPN transistor, just reverse the diode.

As the resistance of the pot is reduced, the note gets higher, and at minimum resistance the monitor is turned off. The simplest way to get *rf* to run the monitor is to connect it to the chassis of the receiver or transmitter; there seems to be enough *rf* floating on "grounded" equipment to run 3 or 4 volts into the monitor in several stations in which this unit has been tried. The volume is loud enough for most shacks and the pitch can be set to suit the operator. The note is by no means a sine wave, but it is pleasant and distinctive. Try it with your transceiver, and break the SSB habit!

John Smith, VK3IQ

SPKR
F1
F2
SQUELCH
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SR SR 76 94
VOL-OFF
MOTOROLA
HANDIE-TALKIE FM RADIO
HT 200

Multi-Cha Operation with the MOTOROLA HT-200

James M. Hagedon, Jr. K8YQH
1335 Brainard Woods Dr.
Dayton OH 45459

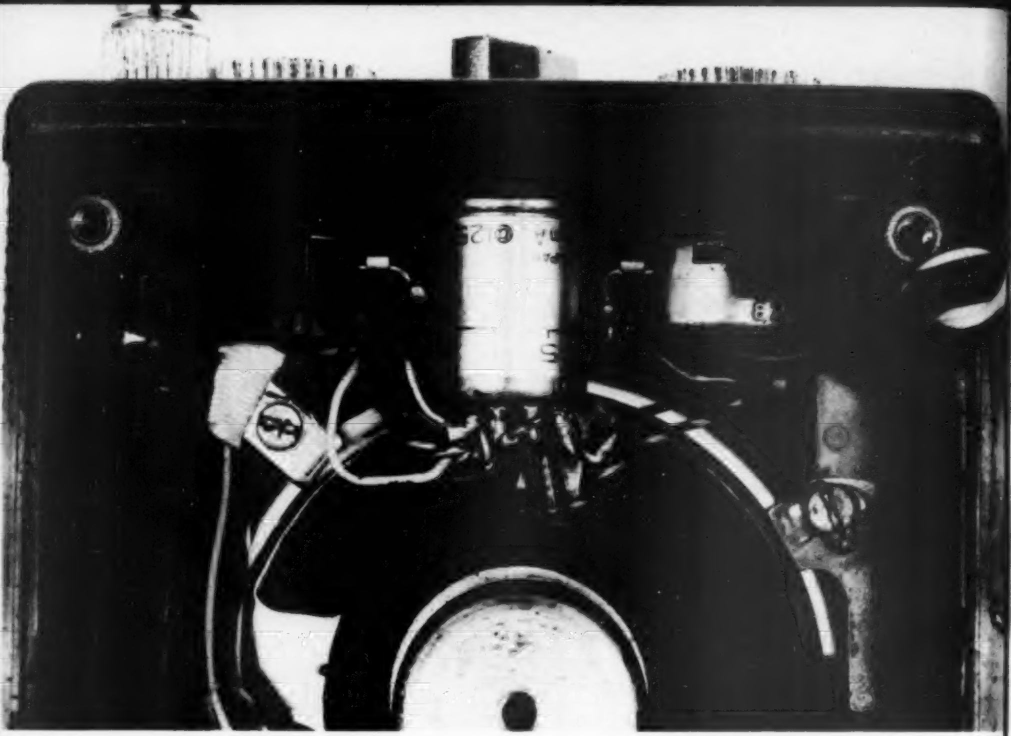
If you are as fascinated with the possibilities of operating the 2m FM bands with hand-held portable gear as I am, you probably have more than a passing familiarity with the Motorola HT-200 (the "brick," as it is known in some circles).

Until recently, this piece of gear has been difficult to pick up on the surplus market. Lately, however, Motorola has released the HT-220, a shirt-pocket unit with approximately the same specifications as the larger HT-200, and many of the "bricks" are beginning to show up on the amateur market at rather reasonable prices.

The Miami Valley FM Association, our local repeater group, recently managed to pick up a fairly large quantity of these units. Unfortunately, however, almost all were single-channel radios. Since our operation utilizes a .34 to .76 repeater, as well as a .94 simplex channel, a dual-channeling program was immediately in order. In addition, a system for providing simultaneous monitoring of both channels was also provided.

This article was prepared to describe the relatively simple process for installing the Motorola second channel transmitter and receiver oscillator decks, as well as describing the switching arrangement which makes simultaneous monitoring of the two receive frequencies possible.

To begin, beg, borrow or steal a Motorola manual for the HT-200. The Motorola manual part number is 68P81058A40-B. It will set you back about $2.50, if you have



Channel switching assembly shown in relation to the interior of the HT case. Although the potting compound has been left off the switch terminals here for the purposes of illustration, it is strongly recommended that epoxy or RTV compound be used for insulation due to the very tight clearances. Diodes are attached directly to the back of the switch.

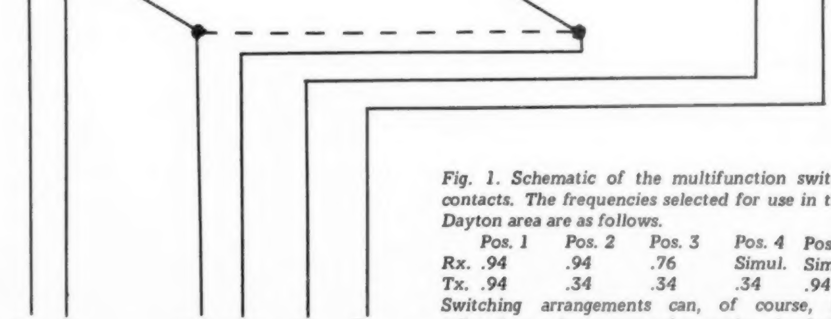


Fig. 1. Schematic of the multifunction switch contacts. The frequencies selected for use in the Dayton area are as follows.

	Pos. 1	*Pos. 2*	*Pos. 3*	*Pos. 4*	*Pos. 5*
Rx.	*.94*	*.94*	*.76*	*Simul.*	*Simul.*
Tx.	*.94*	*.34*	*.34*	*.34*	*.94*

Switching arrangements can, of course, be tailored to suit any area of operation simply by changing contact strapping.

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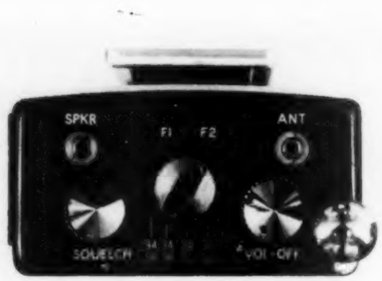


Top plan view of the modified unit, showing the switch modification. The HT illustrated was originally set up for two-frequency transmit, so no hole drilling was required in this case. Note the knob clearance to the ridge at the back edge of the case. This should be about 1/16 in. when a "stock" knob is used.

to buy it, but it contains a wealth of data on your radio, including some excellent views of the transmitter and receiver boards. These would be impossible to reproduce legibly in reduced magazine size, so make sure you have this material available when installing the conversion. Since the one thing that Motorola did not include in the manual is a diagram of the physical location of the transmit and receive oscillator decks, these are shown in the photos.

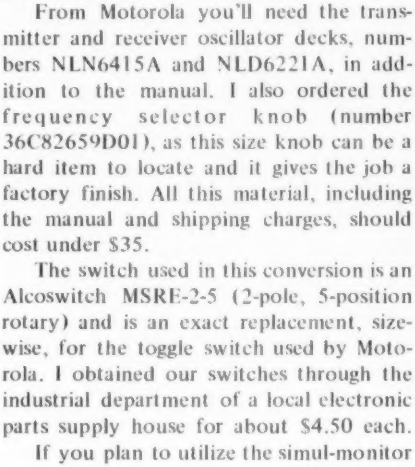
If, after reading the manual and viewing the condensed innards of your "brick" you are thoroughly terrified at the thought of touching a soldering iron to any part of it, take heart. There is nothing there that you won't find on the underside of your T-43 mobile. It's just that what is there is a lot smaller and a heck of a lot closer together. Have a magnifying glass and tweezers available, in addition to your pencil iron, and don't try to do the whole job in one sitting. Incidentally, the manual has some excellent hints on soldering to miniaturized circuits in the introductory section.

Of course, you're going to need some essential parts to do the job and one of the first things you will want to order will be crystals – precision grade. Supply your crystal manufacturer with the Motorola type number and the channel frequency and they'll do the rest. For the receiver, specify a type YMW-35 and for the transmitter a YN-19. When Motorola supplies the transmit rocks, they are shipped with a thermistor temperature compensator soldered across the leads. I have been using crystals without thermistors supplied by both Sentry and International into a narrowband system for some time with no degrading effect, so I would advise you to save a few bucks, at this stage, and request non-thermistor-compensated crystals. Expect to spend $14 to $18 a set.

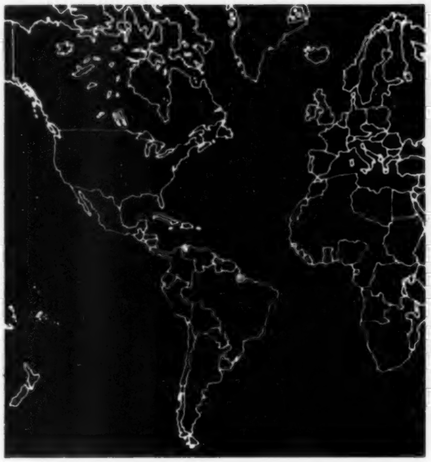
From Motorola you'll need the transmitter and receiver oscillator decks, numbers NLN6415A and NLD6221A, in addition to the manual. I also ordered the frequency selector knob (number 36C82659D01), as this size knob can be a hard item to locate and it gives the job a factory finish. All this material, including the manual and shipping charges, should cost under $35.

The switch used in this conversion is an Alcoswitch MSRE-2-5 (2-pole, 5-position rotary) and is an exact replacement, size-wise, for the toggle switch used by Motorola. I obtained our switches through the industrial department of a local electronic parts supply house for about $4.50 each.

If you plan to utilize the simul-monitor



Relative size comparison of the standard Motorola two-frequency switch (top), and the Alco 2-pole, 5-position replacement. The new switch even maintains the water-resistant specs of the unmodified HT-200.



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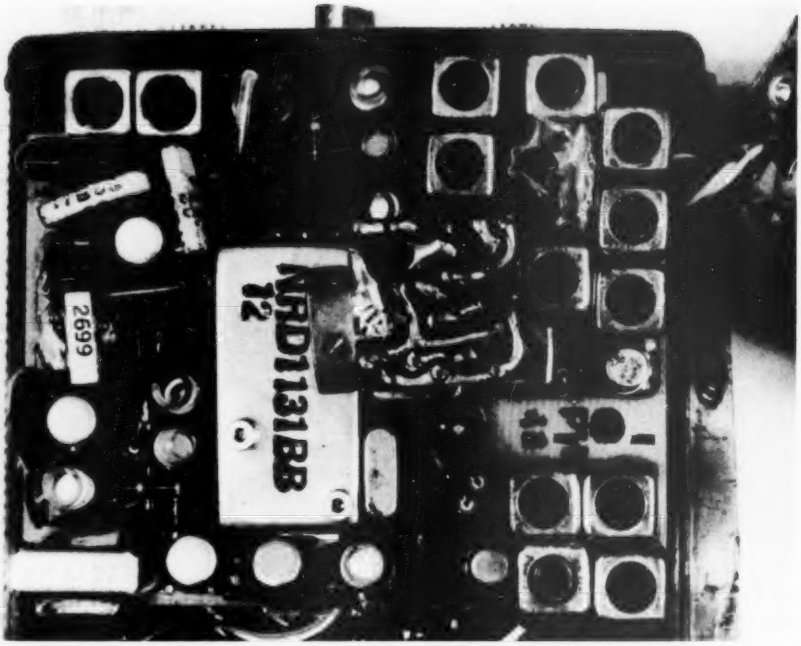


The receiver second oscillator is the small square board with the foil side facing upwards, just to the right of the filter (NRD1131BB) in the center of the board. The assembly is held in place with the screw just to the left of the board.

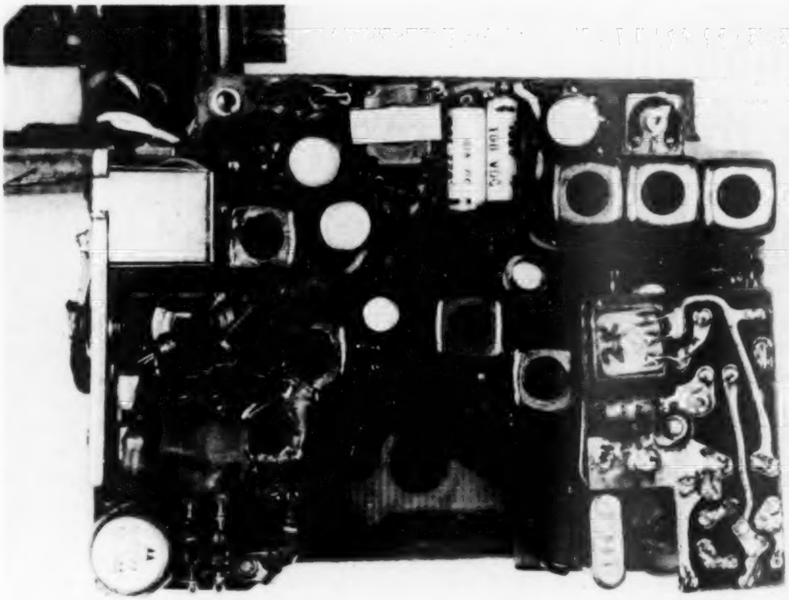
feature, you'll need a couple of small diodes. Anything that will handle a mil or two with a low forward resistance will do. I used HEP 170s simply because they were handy and small.

Installing the oscillator decks on their respective boards is a simple and straightforward job, if you follow the diagrams in the manual carefully. There are several different receiver board schematics covered in the manual, so make sure you pick the right one. Use the number stamped on the Permakay filter for reference. Since both the transmitter and receiver oscillator boards are supplied with all interconnecting wiring cut to length, it is merely necessary to locate the connecting points on the boards and "tack" the wires in place. Refer to the oscillator photos for the physical location of the assemblies. Notice that the boards are mounted "upside-down" in relation to the transmitter and receiver sections and that the interconnecting wiring is pushed through holes provided in the boards. After wiring the decks in place, be sure to disconnect the single-channel jumpers. There are two on the receiver board, so make sure to get them both.

Installation and wiring of the switch is probably the hardest part of the operation. The switching system used in our area is shown in Fig. 1. Simultaneous monitoring is accomplished in positions 4 and 5 by paralleling the receiver oscillators through the diodes. These must be used to isolate the two oscillators in positions 1 through 3.

It is strongly suggested that the switch be wired before installation into the radio. Check your wiring with a VOM and then pot the terminal end of the switch with RTV or similar material to prevent possible shorts. It also helps to make sure all leads are properly identified.

It is a good idea to cut the switch shaft to length to allow it to be inserted into the radio easily. For the knob suggested, the



Transmitter second oscillator board shown positioned over the transmitter module. The oscillator deck is in the lower right hand portion of the photo with the foil side of the board facing up.

shaft length should be about 3/16 in. This operation should be handled with considerable care to avoid snapping the shaft where it goes into the switch body.

Drilling the hole in the top of the HT case is a job that also should be approached with considerable finesse. The hole should be drilled midway between the volume and squelch knobs and 5/16 in. away from the raised area toward the back of the radio. Remove the transmitter board from the case and check to make sure no wires will be hit when drilling through from the top of the case. Using a ¼ in. drill, carefully and slowly make the hole. This is relatively soft plastic, so don't use excessive pressure. A slip at this point could bring out latent suicidal tendencies.

Install the switch and replace the transmitter board to check clearance. It may be necessary to slot the mounting hole slightly with a file to obtain a proper fit. Route the switching leads to their respective boards along the same paths as the original wiring. This is not critical, since no rf is present, but should be as neat as possible to avoid clearance problems. Soldering the leads to the boards and installing the knob should complete the job.

Owners of the PT series of Motorola portables can perform the same conversion described above, as the receiver and transmitter-exciter boards are essentially the same. In these units, however, a Centralab PS105 switch is used instead of the Alcoswitch listed.

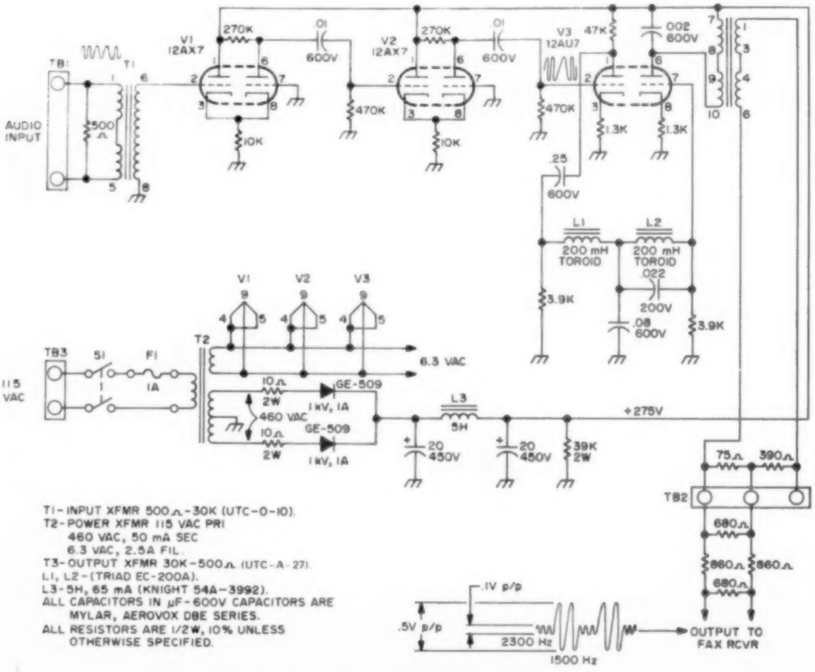
I have personally performed this conversion on a half dozen HTs and PTs in recent months and have been using the system in my own units without problems. Checked on a Measurements Model 80 signal generator, receiver sensitivity is degraded about 0.1 to 0.2 μV, which is unnoticed on all but the weakest signals. Maximum sensitivity can, of course, be restored by switching to one of the single-channel receive functions.

. . .K8YQH■

Facsimile for the Radio Amateur Part II

Bob Dean,
Alden Electronic & Impulse Recording Equipment Co., Inc.

As mentioned in the first part of this article, to copy weather maps and Wirephotos you must have some sort of general coverage receiver, which is stable, reasonably sensitive and selective and has the capability for copying sideband. One such as an R-390 or Collins 51S1F is ideal, but a more inexpensive receiver will occasionally suffice. On many stations, I have received excellent copy using a $100 set. Naturally, the better equipment yields consistently high quality copy. The same goes for an antenna. You can get by with a long wire, but your beam would enable you to produce much better copy. Finally, some sort of converter (Fig. 1) is required to obtain the correct input for the fax recorder. I modified the circuitry of a commercially available model by removal of the tuning indicators. (I use a scope on the output). Using many junk box parts and a few I had to buy, the converter cost about $20. You may be able to locate a converter in the line of military surplus even more


TB1
AUDIO INPUT
500 Ω
T1
V1 12AX7
270K
.01 600V
10K
470K
V2 12AX7
270K
.01 600V
10K
470K
V3 12AU7
47K
.002 600V
1.3K
1.3K
470K
.25 600V
L1 200 mH TOROID
L2 200 mH TOROID
.022 200V
.08 600V
3.9K
3.9K
V1
V2
V3
6.3 VAC
TB3
S1
F1 1A
115 VAC
T2
10 Ω 2W
GE-509 1 kV, 1A
460 VAC
10 Ω 2W
GE-509 1 kV, 1A
L3 5H
20 450V
20 450V
39K 2W
+275V
75 Ω
390 Ω
TB2
680 Ω
660 Ω
660 Ω
680 Ω
.1V p/p
.5V p/p
2300 Hz
1500 Hz
OUTPUT TO FAX RCVR

T1-INPUT XFMR 500Ω-30K (UTC-O-10).
T2-POWER XFMR 115 VAC PRI
460 VAC, 50 mA SEC
6.3 VAC, 2.5A FIL.
T3-OUTPUT XFMR 30K-500Ω (UTC-A-27).
L1, L2-(TRIAD EC-200A).
L3-5H, 65 mA (KNIGHT 54A-3992).
ALL CAPACITORS IN µF-600V CAPACITORS ARE
MYLAR, AEROVOX DBE SERIES.
ALL RESISTORS ARE 1/2W, 10% UNLESS
OTHERWISE SPECIFIED.

Fig. 1. Fax converter.

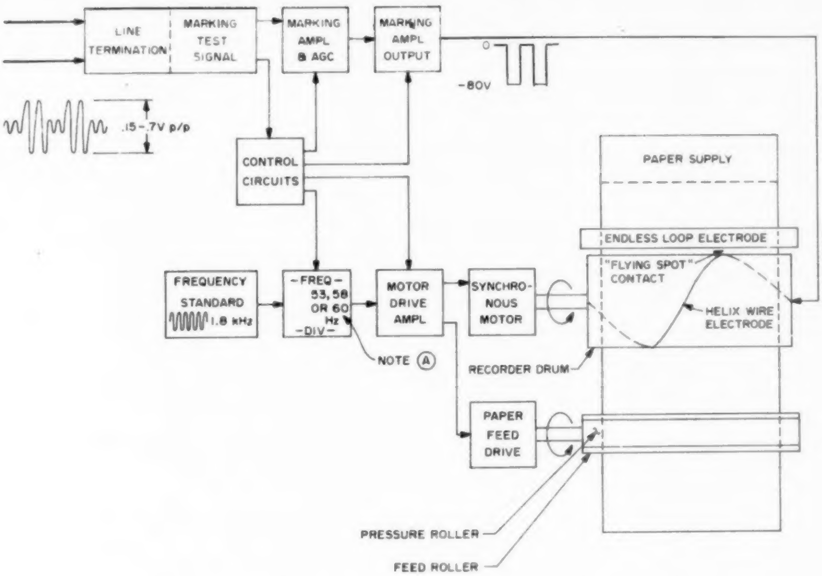

LINE TERMINATION
MARKING TEST SIGNAL
MARKING AMPL & AGC
MARKING AMPL OUTPUT
0
-80V
.15-.7V p/p
CONTROL CIRCUITS
PAPER SUPPLY
ENDLESS LOOP ELECTRODE
"FLYING SPOT" CONTACT
HELIX WIRE ELECTRODE
FREQUENCY STANDARD 1.8 kHz
-FREQ- 53, 58 OR 60 Hz -DIV-
MOTOR DRIVE AMPL
SYNCHRONOUS MOTOR
NOTE Ⓐ
RECORDER DRUM
PAPER FEED DRIVE
PRESSURE ROLLER
FEED ROLLER

Fig. 2. Block diagram of typical recorder with mechanical components.

inexpensively so there are a few models listed in Table I.

A properly operating fax converter should have an output level that varies linearly with respect to the input frequency. This is especially important in obtaining the tonal shades in Wirephotos. For a quick check, merely apply an input from an audio signal generator. Working in 100 Hz steps throughout the input range, monitor the output and graph frequency versus the output level.

The input level required by most facsimile recorders is 0 dBm and below. If the output is taken across the 75Ω resistor in Fig. 1, nearly 0 dBm is attainable. Since many recorders require a much lower signal level, an additional attenuator network must be used to provide the proper amplitude signal to the recorder.

Recorder Operation

In Fig. 2 the block diagram of a typical recorder and a representation of the mechanical components is provided. As in the transmitter, the frequency standard is of primary importance. It ensures that the helix drum will be maintained in sync with the transmitter. With reference to Note A in Fig. 2, the output of the divider block provides different frequencies to the motor drive amplifier. Normally the output frequency used to drive the synchronous motor will be 60 Hz; however, during the starting sequence it is necessary to bring the helix drum of the recorder into coincidence with the transmitter. In this method the synchronous motor is initially started by switching it across the ac line. At this point the phasing signal is received. The divider will drop the output to 53 Hz and the synchronous motor is now switched to the output of the motor drive amplifier. Since the drum of the transmitter is revolving at a constant speed, the drum of the recorder gradually approaches the point of coincidence. As the recorder drum approaches within several degrees of this point, the output of the divider is switched to 58 Hz (this decreases the speed difference between the recorder drum and the transmitter and permits greater accuracy in the phasing of the recorder). At the instant coincidence is reached, the divider output is changed to 60 Hz, and here it will remain until the recorder is shut down or a stop tone is received.

Table I. Facsimile Equipment

Mfg.	Desig.	RPM	LPI	Type
Alden	319EA	60/90/120	96	Continuous Roll, Auto. Electrosensitive 19"
	319EA ("C" Series)	60/120	96	" "
	9217B	60/120	96 or 48/96	" "
	9244	120/240	96, 48/96 or 96/166	" "
	9244MD	60/90/120	48/96	" "
	9244T	120/240	96 or 96/166	19" Transistorized
	9255F	120/240	75/96/166	11" Transistorized
	9225E	120/240	75/96/166	11" Transistorized
	AN/GXT-2 (9165 KTL)	60/120 or 120/240	48/96/166	19 or 11" Format – transmitter –
Muirhead	D-649G/A	60/90/120	96	Continuous Roll, Auto. Electrosensitive 19"
Times Fax.	TXC-1 (TT-321)	30/60 or 60/120	96	XMIT or RCV, photo or electrostatic, single sheet capability
	RD-92	60	96	Single sheet electrostatic copy
	RD-92A	120	96	" " "
	RO-160	60/120	96	" " "
	RO-172	90/120	96	Single sheet
Westrex	UXH-2	60/90/120	96	Continuous Roll, Auto. Electrostatic copy
	UXH-2B	60/90/120	96	Electromechanical copy
	CV-157A	FSK Conv.	2300–3100 Hz, Input Limits	
	CV-157	FSK Conv.	1500-2300 Hz, Input Limits	
	CV-1066A	FSK Conv.	2300-3100 Hz, Input Limits	
	MD-168	FSK Keyer		Fax output freq: 1500-2300 Hz

Assuming that the recorder has been phased and is running at the proper speed, the quasi-sinusoidal amplitude modulated input signal containing image data is applied to the marking amplifier. The output stage of the marking amplifier applies negative going pulses to the helix wire electrode. The helix wire electrode, which is attached to the revolving helix drum and the loop electrode, form a "flying spot contact" with the electrosensitive paper. The loop electrode deposits ions on the paper which causes a mark wherever a signal appears on the helix wire electrode.

The density of the mark varies with the magnitude of the signal voltage on the electrode at a given point; however, the paper is not necessarily linear in producing a mark, with respect to the input signal. Several types of paper are available, one of which enhances tone shades and one that strives to produce strictly black and white copy. This is beneficial as it limits background noise on the recorded copy.

In recorders designed for map and APT reception, the signal to the helix wire electrode is inverted in the marking amplifier in the APT mode. In the map and Wirephoto transmissions, black signal elements correspond to maximum amplitude carrier and at the output of the marking amplifier (in most recorders) this is the maximum voltage applied to the paper. For APT transmissions, just the opposite, black elements are of minimum carrier amplitude but still require the maximum voltage to mark the paper.

Selecting a Recorder

Of primary consideration when selecting the recorder is determining what service it will copy.

I'm partial to recorders using the electrosensitive process (Alfax Type A paper) primarily because they offer a wide range of tone shades. Also, the recorded mark is light-proof and smudge-proof. There are many types of surplus recorders available (Table I again). They are of single sheet capability or offer a continuous recording by means of an internal paper supply.

The speed, paper feed rate, and copy size that can be obtained are also important considerations. For instance, if weather maps or general all-around versatility are required, it would be advisable to select a 19" format recorder which is capable of copying 60, 90 and 120 rpm at 48 and 96 lpi. This will allow you to record almost any maps sent by radio fax. The primary operating speed is 120 rpm at 96 lpi. You could also use a recorder with an 11" format to copy these maps as long as the speeds were attainable. However, the paper feed rate to obtain a symmetrical copy must be 166 lpi (corresponds to 96 lpi transmitted on a 19" format) or 82 lpi (which corresponds to 48 lpi on the 19" format).

If Wirephoto pictures are to be copied, a recorder that operates at 60 rpm (19" format about 72 lpi or 11" format approximately 120 lpi) is required. Actually the 11" recorder appears to be standard for this type of reception, but I've received many good pictures from the 19" unit.

For Wirephoto reception you may obtain a 19" recorder which was originally designed to copy weather maps that will provide the correct speed and approximate paper feed rate without modification. This recorder (Alden Model 319A), like my own, is one of the older models. It has a mechanical shift motor drive and a separately selectable mechanical shift paper feed. The unit will run at 60 rpm and approximately 72 lpi if the paper feed selector is placed in the position normally used when running at 90 rpm. (Similarly, 60 rpm operation at 48 lpi would be attainable to copy weather maps by running the paper feed unit at 120 rpm). This is possible simply because the paper feed rate in this unit is independent of the motor drive. Using this type of setup leaves one final problem, that of a mirror image. There are several solutions to this and they are discussed at length below.

I could go on describing the requirements for each individual situation, but in preference to this I made up a table (Table II) which contains all of the data you are likely to need in selecting the correct recorder.

Mirror Image

Both the weather services and wire services make use of similar equipment. Both can be copied using essentially the same techniques. The only problem I have encountered is that referred to as a mirror image. Basically, it means that if a standard weather map recorder is used on Wire-

Table II. Fax Recorder Selection Data

Service Copied (Recorder Requirements)		**Speed**	**LPI**	**Copy Size**
ATS Satellite	Mosaics,	240	75	11" Recorder
	Experimental	240	96	
		240	166	
	Chart Relay	120	166	11"
		120	96	19"
APT Satellite	PIX	240	75	11"
	DRIR (150° sweep)	48	82	11"
Wirephotos	(Mirror Image)	60	72	19"
		60	120	11"
Weather Maps		60/90/120	48 or 96	19"
			83 or 166	11"
Amateur Fax		60/120	96	19"
SSTV and other experimental usage		Standard 19" recorders operate at up to 960 RPM @ 96 LIP and @ 48 LPI and the smaller recorders go 3600 RPM on a 2" format so there are many possibilities.		

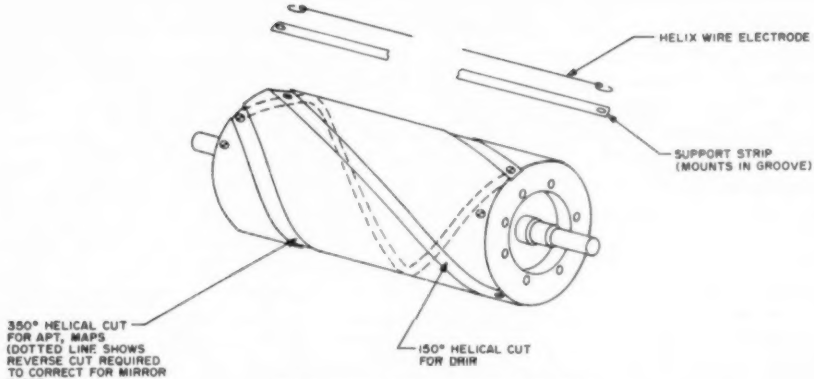

HELIX WIRE ELECTRODE
SUPPORT STRIP (MOUNTS IN GROOVE)
350° HELICAL CUT FOR APT, MAPS (DOTTED LINE SHOWS REVERSE CUT REQUIRED TO CORRECT FOR MIRROR IMAGE
150° HELICAL CUT FOR DRIR

Fig. 3. Mirror image correction method.

photos the pictures come out reversed with respect to left and right. There are ways to correct this problem in some recorders.

The electrosensitive paper I use is translucent so if the recording is made using a standard weather map format recorder, the copy will be reversed, but if you turn it over and provide backlighting the image will appear as it would in the newspaper. This is by far the easiest solution.

A more correct method would be to use a printing device constructed just in reverse of the standard model (see Fig. 3).

This may be difficult to construct at home, but it could probably be obtained to fit one of the surplus ALDEN recorders.

In another printing method three styli are used; they rotate on a steel band or cogged belt so that one is in contact with the paper at any given instant. To correct the mirror image in this type of machine, the reversal of the direction of rotation is the answer. It would also be necessary to change the stainless steel plate to the other side of the paper. The function of this plate is to allow the styli to get onto the paper without grabbing the edge, and causing "jitter" in the recording.

Due to the type of paper used, backlighting will have less affect in allowing the image to show through. If you have this type of recorder and don't want to make any mechanical changes, just hold the copy up to a mirror to read the caption. It will make little difference to the viewer that the picture itself is reversed when viewed normally.

Still another type of recording technique (Fig. 4) involves a single sheet of copy clamped by one end to the steel recording drum and uses electrostatic paper. This method has an electrode which burns coating from the paper stock leaving a mark. This particular type of recorder would have to be completely redesigned mechanically to correct the mirror image.

The drum would have to revolve in the opposite direction which means the stylus must be reversed and the paper clamped to the drum on the other side. Possibly the drum could be turned end for end which would take care of the clamp problem; but the mechanics of reversing rotation, I'd leave up to you. Again, you could make use of the mirror to view the copy as it should look as the paper will not pass light easily.

APT Operation

Unless you obtain an 11" recorder designed for APT reception, there are a few basic details that you should know about. For instance, the signal is reversed in the output stages of the marking amplifier (with respect to weather map recorders) so that minimum carrier corresponds to black and maximum carrier is white. Utilizing this method yields more detail in the lighter shades of gray. Normally 16 shades of gray are obtainable, and from the subtle differences in color in the received picture, you can determine the make-up of the land masses and bodies of water, as well as the demarkation between snow and ice. Not all

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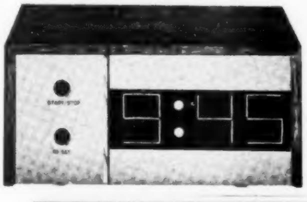

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facsimile recorders will correctly reproduce these subtle color changes. In these recorders, it is necessary to change the biasing on the output stages of the marking amplifier so that the input signal will act linearly in producing a mark. This is referred to as gamma correction. If gamma correction circuits are not utilized you may expect an APT picture which has both the black and white portions but very few middle shades.

Another factor to be considered is that of Doppler Shift. (This shouldn't pose any appreciable problem to the amateur; but it is included to explain its affects.) On an orbit where the satellite is passing nearly overhead you will note that the recorded pictures will display drift in one direction, then run straight, and finally drift the opposite way. Now, drift in the recorded copy generally indicates that the standards of the transmitter and recorder are not matched. In this case, however, the satellite is approaching your location at a relatively high velocity and departs the same way. Here we have the greatest amount of Doppler Effect on the signal and consequently drift first in one direction, then the opposite way. While the satellite is nearly overhead or passing to either side, on the horizion the relative velocity is quite low, hence the Doppler Effect is not as pronounced in the recorded copy. Commercial units compensate for the Doppler Effect by using an AFC. Here the input signal may be amplified, then limited, to remove all modulation and used as the drive signal, bypassing the standard. Another method is to use this signal to control another oscillator which provides the drive. In this manner, if the input signal is lost for an instant, the recorder will not change speed appreciably. Using an AFC in this case is possible because of the relatively low noise path from the satellite due to use of VHF-FM along with noise filters for removing all but the 2400 Hz signal.

Besides the recorder, reception of APT pictures will require more specialized equipment. An FM receiver, operating from 135 to 140 MHz, preferably crystal

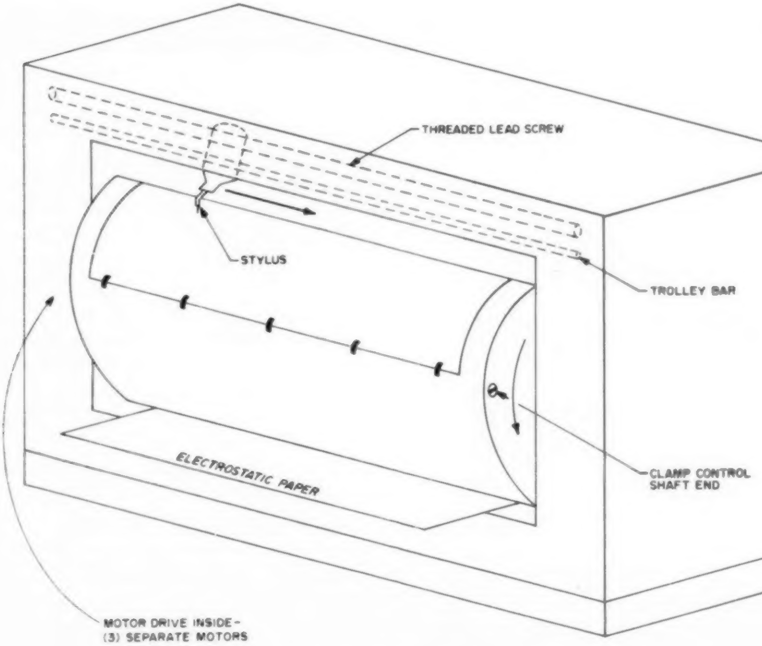

Fig. 4. An electrostatic recorder.

controlled, is a necessity. I mention a crystal controlled FM receiver primarily for convenience; actually a tunable set can be used if you have an accurate method of placing it nearly on frequency before the acquisition of the satellite you wish to copy. I experimented with inexpensive, commercially available VHF FM receivers some time ago and found the GE ER-52A has the necessary requirements.

Antenna

As far as antenna elements are concerned, you could probably construct one without much effort. The antenna normally used is a 10 element, half-wave cross-yagi with phasing harness to provide right-circular polarization for optimum reception. Or, if you prefer, the Cush-Craft people make just such an antenna.

As far as transmission line is concerned, RG-214 should be run right up to the base of the azimuth rotor, where mechanical considerations necessitate the use of the more flexible RG-58 for the connection with the antenna elements. Even though low loss cabling is used, it is advisable to install a pre-amp between the RG-214 and RG-58, although it may not be necessary if an extremely short run of transmission line is used.

Most commercially available systems supply pre-amps with cable runs of less than 100 feet. In many cases, the extra gain will not be required but in typically noisy locations it will be appreciated if not essential!

The ATS is in synchronous orbit and does not require a movable antenna, however, if you are attempting to track the ESSA, Nimbus & ITOS satellites a trainable antenna is a must. The better systems allow 720° of azimuth rotation and approximately 190° of elevation movement. A system such as this would be prohibitively expensive for the amateur to construct so an alternate is suggested (see Fig. 5). By using two commercially available rotors (such as the TR-44) and modifying one to limit rotation to 190° you can build a suitable system. It is still not inexpensive, however.

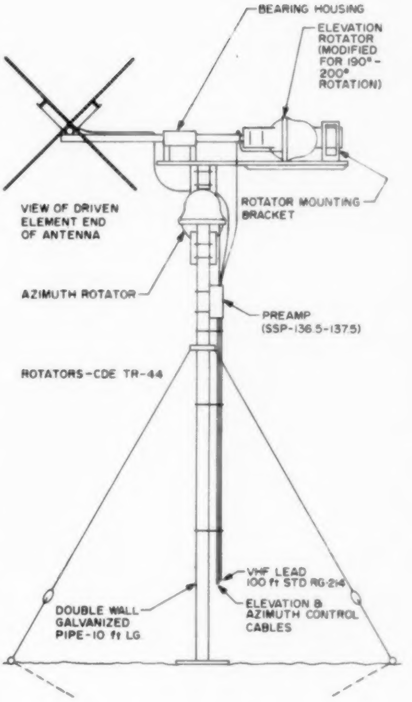
BEARING HOUSING
ELEVATION ROTATOR (MODIFIED FOR 190° - 200° ROTATION)
VIEW OF DRIVEN ELEMENT END OF ANTENNA
ROTATOR MOUNTING BRACKET
AZIMUTH ROTATOR
PREAMP (SSP-136.5-137.5)
ROTATORS-CDE TR-44
VHF LEAD 100 ft STD RG-214
DOUBLE WALL GALVANIZED PIPE-10 ft LG
ELEVATION & AZIMUTH CONTROL CABLES

Fig. 5. Weather satellite tracking antenna.

Satellites of the ESSA class transmit a solid carrier between images almost equal in duration to that of the picture. Thus, frames from ESSA satellites have only slight area overlap. By contrast, Nimbus satellites transmit a continuous stream of pictures which result in nearly 50% area overlap. Normal speed of transmission in each case is 240 rpm and using a paper feed rate of 75 lpi on an 11" format for exact reproduction (10.2" x 10.2").

Both classes of satellites make two daily passes over the same general area, once during daylight and once during darkness. However, with a good receiving location, the satellite will often be within acquisition range for three consecutive passes. This gives the ham the opportunity to see not only the cloud cover directly overhead, but that of a wide area around him. The period of rotation varies slightly but is approximately 107 min./orbit. The ESSA type has an orbit track running generally from North to South and the Nimbus is opposite going South to North during the daylight passes.

It might also be of interest to note that the Nimbus type of satellite has the capability of recording information from an infrared scan. This is normally the mode used during the nighttime pass, but may be controlled from the ground to transmit in this mode continuously. The speed of operation for this mode (DRIR) is 48 rpm and 82 lpi on the 11" format. I must say that I have never had experience copying this infrared scanning mode but data obtained by its use (after processing) appears nearly identical to the daylight mode images. Besides the speed differences, it is of interest to note that only 150° of the scan contains useful picture data. You could use a standard APT recorder to copy the DRIR if you could change the speed; however, the useful data will be compressed. It is possible to expand this data so it occupies the entire frame. This would necessitate another type of printing helix which would sweep completely across the frame in 150° of the drum rotation. Thus, for 210° of the scan line no electrode is in contact with the paper, hence the useless data (where the inside of the infrared scanner housing, and area beyond the earth horizon are scanned) is eliminated. Also, the marking signal level must be reduced to keep the same image density as the relative marking speed was lowered.

Operating Frequencies

A few of the most common operating frequencies are listed here to save you from searching for them; although, this will be necessary for Wirephoto frequencies as many of them are changed periodically depending on the propagation conditions.

Satellites operate at 135.6 MHz, 136.95 MHz, 137.50 MHz and 137.62 MHz for the ATS, Nimbus, ITOS and ESSA respectively. Information pertaining to the orbits or plotting data for gridding is obtained by contacting:

National Meteorological Center
Environmental Science Services Adm.
Suitland MD

or contact:

Nimbus Project Code 450
National Aeronautics & Space Adm.
Goddard Space Flight Center
Greenbelt MD 20771
Attn: Nimbus APT Coordinator

They will be able to advise which publications should be obtained.

Now, for a few of the common frequencies used to transmit weather maps: NSS Washington DC keys several frequencies and most are up continuously.

3,357 kHz, 4,975 kHz, 8,080 kHz, 10,865 kHz, 16,410 kHz and 20,016 kHz – maps originate from Suitland MD or FWC Norfolk VA.

CFH Halifax NS keys 4,271, 9,890, 13,510 and 17,560 simultaneously. Maps are transmitted every hour on the hour. RTTY transmissions are made on the same frequencies, usually immediately preceding the fax portion of the broadcast. If you want to try a little DX on fax, Fleet Weather Central, Rota, Spain keys this group of frequencies. Most of them are up and keying continuously: 3,713, 5,420, 7,417, 9,875, 12,145, 15,941.5, 19,019 kHz.

Further information on fax frequencies in use can be obtained by contacting:

U.S. Naval Oceanographic Office
Washington DC

Ask about publication H0118A, Section 4. This contains all data pertinent to fax weather broadcasts for eastern North America, Europe and Africa. They have another publication dealing with the Pacific as well. You might be interested to note that the other sections of this publication contain data pertaining to all other radio weather broadcasts, both RTTY and CW. They also have a section on interpreting data from both the maps and RTTY broadcasts.

In conclusion, hopefully, this conglomeration of details and basic facts dealing with facsimile have served to answer at least a few of your questions pertaining to the subject. Now, the main intent in

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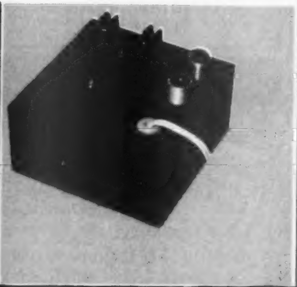

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"BLOCK BOOSTER"
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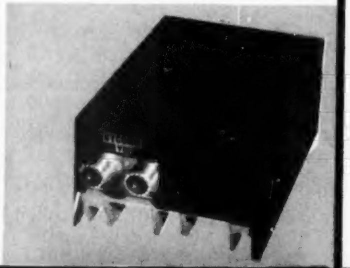

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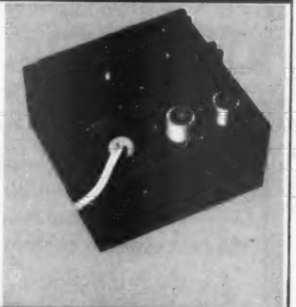

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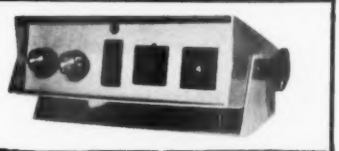

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writing the article was to provide you with enough facts so you could start exploring the field.

I bought one of the oldest machines ALDEN is offering as surplus because it provided the features I wanted, and with a few hours effort it's working like a new machine. As far as parts availability is concerned, any facsimile recorder has wearable parts. Many of these could be fabricated locally, but some of the very old World War II vintage military recorders probably will give you a difficult time locating any ready made spare parts.

All in all, if you are interested by all means be selective in any surplus you might obtain. Let's face it, if it won't be able to copy what you want or if you can't get spare parts easily it's not going to be much of a bargain . . . or much fun!!

Glossary of Basic Terms

Drum Speed – speed of rotation – RPM.

Paper Feed Rate – longitudinal copy speed.

LPI – lines/inch – number of scan lines per inch of copy.

APT – Automatic Picture Transmission (satellite cloud cover).

ATS – Applied Technology Satellite (relay satellite).

Electrostatic – method of printing involves burning of coated paper with controlled arc.

Electrolytic, Electrochemical, Electrosensitive – printing of paper by passing dc through it, which leaves a mark due to chemical action.

Electromechanical, Pressure Sensitive – two rolls of paper are fed together, a bond paper roll beneath a layer of carbon paper. The marking impulse causes a solenoid type printing stylus to strike the paper leaving a mark.

Helix – a printing electrode generally associated with the electrosensitive method.

Stylus – a printing electrode used singly or in groups of 3 (per machine).

Tuning Fork – usually used for an internal standard.

Drift – a problem most often noticed at the recorder. The copy runs off one side of the page or the other. It may be that a difference exists between the standards of the transmitter and recorder or may be due to a mechanical bind. To make certain the recorder is not at fault, try copying another station or one of the time standards. If the copy then runs straight the problem is at the transmitter. If not, check your recorder. (Note: different when copying satellites. See problems caused by Doppler Shift).

Skew – another term for drift.

Phase, Frame or Sync – basically all describe the signals used to center the image on the recorder.

Sync Motor – synchronous motor used in nearly all facsimile equipment to precisely control drum speed.

Lead Screw – device on transmitters of the drum type which supports the drum, is rotated by the sync motor and is threaded to effect the longitudinal motion of the copy.

Half Nuts – usually made of brass, these engage with threads on the lead screw. To provide longitudinal motion.

Stepping – abrupt shift in copy usually due to defective divider chain, bind, power fluctuation, etc. Check same as for drift.

Jag – Jitter – minute steps in copy usually due to a mechanical bind. Looks like a saw tooth edge on all vertical lines. May be transmitter or recorder. Check same as for drift.

Line Grouping – problems with this generally in 3 styli recorders where all 3 are not all at the same height. Usually every third line there will be a horizontal gap in the copy.

Gamma Correction – most any recorder will produce gray shades between black and white. Gamma correction is a change in the bias of the marking amp output stages which makes the recorder show linear differences in density with respect to the input level.

With this collection of terms, you have the basics with which to discuss almost any aspect of facsimile, including any problems you might encounter.

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Man-Made Interference
Its Causes and Cures

Every amateur, at one time or another, has experienced poor reception as a result of interference from man-made sources. This is not to be confused with interference in the form of QRM from other amateurs. That's a subject in itself. The problem referred to is interference in the form of QRN created by electrical sparks, spurious radiations, or electrostatic discharges. More commonly, it is referred to as "static."

The fact that noise can be a serious problem is evidenced by the number of receivers on the market today with some form of noise limiting circuitry. However, few of these receivers can filter out all forms of noise completely without sacrificing receiver sensitivity. That's the reason why most manufacturers specify receiver sensitivity as . . . "so many microvolts for a 10 dB signal plus noise-to-noise ratio." This is the minimum acceptable level for the exchange of intelligence in communications. As the noise level increases, the incoming signal strength must also be increased to maintain the minimum ratio. This background noise level can come from one or more of the following sources: (1) cosmic radiation from outer space, (2) terrestrial "atmospherics" due to lightning and similar types of electrostatic discharge, (3) internal receiver noise that is a function of its design, and (4) man-made interference. The first two sources mentioned, cosmic and atmospheric noise, are completely beyond our control. In regard to the third source, most manufacturers have done an excellent job in designing receivers with low internal figures. This leaves the last major source – man-made noise – as the only area that can be controlled to insure reliable communication.

This article will therefore propose methods of locating and eliminating sources of man-made interference. Definitions, descriptions, and causes of interference will also be covered.

During the past couple of years, while working for a local power company, this writer has been involved in numerous attempts at locating and eliminating noise sources along power lines and in consumer locations. Through these experiences it can be concluded that man-made interference can occur at any hour of the day or night, can be steady or intermittent, can come from every imaginable source, and is not always easy to locate. While man-made noise sources appear to be elusive, they have a few things in common that make the hunt easier: (1) They are all the result of an electrical spark, spurious rf energy or an electrostatic discharge; and (2) all sources are reasonably close to the receiver experiencing the interference.

Spark Discharge Noise

Webster's dictionary defines noise as

“. . . unwanted signals in an electronic communication.” In a broader sense, noise can be considered anything that *interferes* with the exchange of intelligence in electronic communication. Since man-made interference falls in this category, let's look at the major types of noise.

Whenever there is a breakdown in insulation of a current carrying circuit, or the making and breaking of minute conducting paths in the components of a system, noise is generated. This type of interference is called “breakdown” or contact noise and it occurs in many different forms over a wide frequency range. Power-line interference is a major offender in this category. The

Table I. Spark Discharge.

NOISE TYPES	NOISE SOURCES	CHARACTERISTICS	REMARKS/REMEDIES
BREAKDOWN OR CONTACT	*1. Power Line*		
	a. loose connections	a. frying, low pitched	1. In all cases of Power Line Interference, the local power company should be called upon to make the necessary corrections. For safety reasons, it is best for the amateur to stay off poles and other facilities. The amateur can assist the power company by describing the noise, determining its frequency and general location. See text.
	b. loose tie wires	b. fying, low pitched	
	c. faulty insulators	c. buzzing, raspy	
	d. lightning arresters	d. hissing	
	e. loose hardware	e. popping, irregular	
	f. tree limbs	f. frying, irregular	
	2. Thermostatically Controlled Devices		
	a. heating pads	a. buzzing, raspy	1. Install capacitor filters as close to the thermostat's contacts as possible.
	b. refrig. butter conditioners	b. buzzing, raspy	
	c. aquarium water heaters	c. buzzing, raspy	
	3. Other Devies		
	a. neon signs	a. buzzing, raspy	1. Insulate neon signs completely. Bond isolated conductive material in the field of the sign.
	b. fluorescents	b. 80 & 40 meters	2. Fluorescent lights provude RF energy from 3400 kHz to 8300 kHz.
	c. Dimmer switches	c. buzzing, raspy	3. In the case of an arcing doorbell transformer, the entire unit should be replaced.
	d. elect. fences	d. irregular	
	e. faulty doorbell transformers	e. intermittent buzzing	4. Noise generated by an electric clock can sometimes be cured by thoroughly cleaning the internal mechanism and checking the wiring.
	f. elect. clocks	f. irregular buzzing	
ROTATING ELECTRICAL MACHINERY	*1. Appliances with Brush Type Motors*		
	a. elect. mixers	a. all brush-type motors will produce a whining type noise & produce streaks on a TV screen.	1. Install filter capacitor at motor with effective grounding. 2. Seat brushes and turn down commutator.
	b. elect. shaver		
	c. vacuum cleaner		
	d. small motors		
	e. elect. saws		
	2. Ignition Noise	a. popping noise varies/speed	1. See text.

generation of noise can result from loose connections, tie wires, or hardware; faulty insulators or lightning arresters; or tree limbs touching bare conductors.

Power Lines. Loose connections and tie wires produce a frying, low-pitched noise resulting from electric currents conducting through oxide paths or by actual sparking of the conductors. In some cases, the noise will be intermittent and will occur only when the conductors are disturbed by wind or other means. Locating the actual noise source in this situation will be a frustrating experience, but well worth the trouble if the noise can be completely eliminated.

Noise generated from faulty insulators and lightning arresters can be the result of a breakdown in insulation or from contaminants such as dirt and moisture. The sounds associated with this type of interference have a buzzing or raspy note and are usually easy to identify.

Trees touching bare conductors are a major source of noise problems.

Quite often, trees are planted near power lines and eventually come to be a problem. The branches usually grow high enough to become entangled in the bare primary conductors. The resulting noise is a frying, low-pitched type that is very irregular. However, a branch touching a bare conductor is probably the easiest situation to identify from the ground. As

Table II. Spurious Radiations.

NOISE TYPES	NOISE SOURCES	CHARACTERISTICS	REMARKS/REMEDIES
1. RF ENERGY	1. Devices Radiating RF Energy a. heliarc welder b. induction soldering machine c. diathermy machine d. TV receivers e. BC Band & Amateur Rcvrs	a. all sources produce either a whining, buzzing, whistling, or warbling sound.	a. Check the frequency and harmonics of the source. The units should be well shielded and grounded. If necessary, install traps and filters tuned to the frequency of the interference. (These remedies refer to Sources a, b, and c.) For Sources d and e, shield complete and check stages for proper neutralization.

Table III. Electrostatic Discharge.

NOISE TYPES	NOISE SOURCES	CHARACTERISTICS	REMARKS/REMEDIES
1. Static Discharge	1. Sources not connected directly to electrical circuit		1. Rework and tighten all areas of metal to metal contact. Check all ground connections. 2. For belt, wheel, and tire static, bond metal surfaces together with a copper strap. Install front wheel static collectors and inject antistatic powder into tires through the valve stem.
	a. loose contacts between metal objects in electric field.	a. irregular, popping	
	b. guy wires rubbing together	b. irregular, popping	
	c. antenna lead-in wires loose.	c. irregular	
	d. loose metal strap holding mast.	d. intermittent	
	e. belt, wheel & tire static	e. popping, crackling	

in all cases of power-line interference, always let the power company make the necessary corrections. This is by far the safest approach to the problem.

Thermostats. Thermostatically controlled devices such as heating pads, refrigerator butter conditioners, and aquarium water heaters can also generate interference. The characteristic of this type of noise is a buzzing, raspy sound that switches on and off at a certain rate.

Other devices that can also cause problems are neon signs, fluorescent lights, dimmer switches, electric fences, faulty doorbell transformers, and electric clocks. Many doorbell transformers are located in attics along with the rest of the wiring. In hot climates, the attic can reach temperatures as high as 150–160°F. With this high ambient termperature, and the additional heat generated by the transformer itself, the insulation breaks down and severe arcing can occur. This situation is quite common in the southern states during the summer months.

Rotating Electrical Machinery. Appliances with brush-type motors are also producers of noise interference. These appliances include mixers, electric shavers, vacuum cleaners, small shop motors, and electric saws. The noise produced is a raspy, whining sound and a TV screeen would display horizontal streaks.

Ignition Noise. A discussion of spark discharge noise would not be complete without mentioning ignition noise. This type of noise exhibits a popping sound at a rate that varies with engine speed. Its intensity increases as you come closer to the source. With the exception of internal receiver noise limiting, very little can be done to control the noise at a fixed station location with vehicles traveling nearby. Sometimes a capacitor across the speaker terminals will help to eliminate the sharp impulses. Of course there are many types of suppression that can be incorporated in a mobile installation to silence the mobile vehicle itself. However, since we are discussing fixed receiver installations, the subject of mobile noise suppression will not be covered in this article.

Spurious Radiations

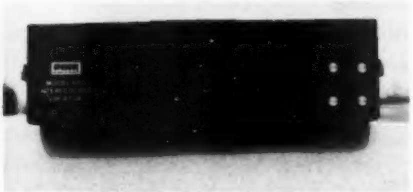
RF Energy. Devices that can radiate energy and interfere with communication are heliarc welders, induction soldering machines, diathermy machines and local oscillators in TV and other types of receivers. These noise sources are generally easy to find since they are producing rf energy at a particular frequency with harmonics. The sounds produced can be identified by their whining, buzzing, whistling, or warbling characteristics. The spurious signals are usually the result of improper or inadequate shielding or grounding and as a result may produce harmonics over a wide spectrum.

Static. Static noise results from metal objects that are not connected directly to an electrical circuit. For example, one source of static interference can come from loose connections between two metal objects in an electric field. Other sources can be guy wires rubbing together, loose antenna lead-in wires, or loose metal straps connected to a tower. Also falling within this category would be belt static and wheel and tire static. These last forms of static discharge are more pronounced in dry climates and are more troublesome in mobile installations. In most cases, however, the noise source is very close to the receiver being interfered with and consequently the noise source is easy to locate.

Locating Noise Sources

At Louisiana Power and Light Company, a Sprague Interference Locator is used to pinpoint noise sources. This receiver tunes from 550 kHz to 200 MHz continuously in five bands, has a signal strength indicator, and comes with several types of directional antennas. While the Sprague receiver performs admirably, any other receiver that has an rf gain control can be used with similar results. Also, it helps if the receiver used has a signal strength meter, a means of disabling the avc or agc circuit, and a directional antenna.

How do we find the noise? It is usually best to start first in the home that is



At Louisiana Power & Light Company, a Sprague Model 600 Interference Locator is used. It is a battery powered receiver that tunes from 550 kHz to 200 MHz in five bands.

experiencing the noise problem. Take the receiver to the main breaker panel and cut off one house circuit at a time. If the noise persists after all the circuits have been deenergized, then it's safe to assume that the noise is not coming from a source within that home. If there are several hams in the neighborhood picking up the noise, there's a possibility that they can help in the search. By turning beam antennas until the peak noise level is reached, the general area of the noise source can be determined. However, this method may not work in all cases.

The next step is to set the rf gain on the battery receiver where the noise is just audible. It is usually best to start on a low band or frequency (80 meters is best for the first try). If the intensity of noise increases as you move through the neighborhood, you are headed in the right direction. As you get closer to the noise source, move to a higher frequency on the receiver; the reason being that the higher frequency harmonics of the noise source will travel shorter distances. Finally, you will be very close to the noise source when it can be received around 200 MHz. This is usually the best frequency for zeroing in on a noise source.

The first place to start is at the main breaker panel of the house experiencing the trouble. Here the author is working with a power company serviceman to locate the noise.

It may take many trips around the neighborhood, listening on different frequencies, and plenty of patience to find some noise sources. Intermittent noise sources may take several weeks to track down. However, to eventually locate and eliminate a troublesome noise is often worth the effort. Also, you may get a few false readings while tracking down the noise. For example, in locating power-line interference, remember that the conductors can act as a huge antenna and radiate noise over a wide area. Also, as you walk along a power line, the noise will diminish and intensify several times. This is due to the standing wave pattern that is set up on the conductors acting as a "transmission line." So don't be fooled by some of the readings you may obtain. The key words are patience and perseverance.

Recommended Remedies

Power Line Interference. Once you have determined that the interference is probably due to some portion of the power company's facilities, the best thing to do is call the local office and ask for the engineering department. Give the engineer all the information available regarding the frequency of the noise, its general location, a description of the interference, and the time of day that it occurs. Above all, leave all remedial action to the power company – they have the necessary equipment to do the job safely.

Devices Controlled by Thermostats. Should the noise be traced to a thermostatically operated device, the first thing to do is check to see if the device is operating properly. Then, filter capacitors should be installed as close to the contacts as possible.

Rotating Electrical Machinery. To effectively eliminate noise produced by brush-type electric motors, the brushes should be reseated. Then filter capacitors

It's best to leave remedial action on utility poles to the power company. They have the equipment to do the job safely.

should be installed with an adequate ground.

Spurious Radiations. Radiations from TV and other types of receivers can be eliminated with proper shielding of the unit. Also, the individual stages can be checked for neutralization. The unit should be grounded.

For radiations from rf heating and diathermy machines, first determine the fundamental frequency and harmonics generated. If the interference persists after the unit is shielded and grounded, it may be necessary to install a trap, tuned to the fundamental frequency of the noise.

Static. In regard to belt, wheel, or tire static, several measures aid in the elimination of noise. First, tighten all connections that could be a source of trouble; where necessary, bond the metal surfaces together with a flexible copper strap. Front wheel static collectors can be installed, but they should be checked every 5000 miles for wear. Also, antistatic powder can be injected into the tires through the valve stems.

Conclusion

In a discussion of this type, there's a good possibility that some of the causes of man-made interference have been unintentionally omitted. Since many of the examples listed were taken from my own experiences at Louisiana Power & Light Company in a specific locality, they cannot represent all possible conditions. You may experience a particular type of noise that is a characteristic of your area only, and does not occur elsewhere. If this is the case, the noise type will not appear in the tables, but the source can still be located by using the techniques described. This is particularly true for man-made interferences, since they all radiate some form of electrical energy. Then, with the aid of a battery-powered receiver, the origin of the noise can be easily pinpointed.

Another characteristic that helps to identify the interference as coming from a man-made device is the fact that most of the radiated energy will be vertically polarized. So if the intensity increases when switching to a vertically polarized antenna, it's safe to assume that the origin is man-made.

Since the problems of generated noise have plagued radio reception for such a long time, many amateurs have needlessly accepted interference as a fact of life. There is no question that great strides have been made in reducing background noise to an acceptable level. For example, imagine what it would be like if the rotary spark transmitters were still in operation! On the receiving end, several noise limiting circuits have been perfected that suppress many forms of noise almost completely. However, for a high concentration of noise, or for occurrences of interference that are persistent, the best solution is to eliminate the source itself. If this approach is chosen, you should find the techniques described in this article useful.

. . .WB5DEP■

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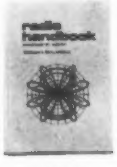

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A group of West Coast hams are planning to fly an engineering prototype of the Oscar A-O-B transponder similar to the one to be launched on a NASA Booster next February. The test flight will be similar to the flight made last May 15th on the East Coast. The West Coast flight will take place late in September if plans presently under way are completed. Special QSLs will be provided for the flight from Los Angeles to San Francisco. Up-link is from 145.90 to 146.00 MHz and down-link is from 29.45 to 29.55 MHz. Special FCC authority has been given for Technican Class licensees' transmissions to be retransmitted on the 10 meter band. The call used will be WA3NDS. Further information will be broadcast on 7225 kHz.

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A Linear, Stable VFO With a Tracking Mixer

Probably the heart of any receiver or sideband transmitter is the vfo. I favor the crystal-controlled first oscillator, followed by a tunable i-f with a vfo to heterodyne to the intermediate frequency. The vfo described in this article is designed to provide a good starting point for the construction of a homebrew receiver or transmitter. When set up for receiving, it takes a 6.455 to 5.455 MHz tunable i-f and heterodynes it to a fixed i-f of 455 kHz. Set up for transmitting, it heterodynes a 455 kHz sideband signal to the tunable i-f (see Fig. 1).

Plenty has been written about stability, so we won't dwell on that here. However, silver micas should be used throughout. They used to be expensive, but now they go for 28–36 cents. Let quality be your guide in selecting components . . . which doesn't necessarily mean a big cash outlay if you're a good scrounger. As far as mechanical stability goes, my unit is built out of 1/8 in. aluminum panel material. It's just about as solid as it can be . . . and the hacked-up fingers I got trying to cut the stuff with a hacksaw don't feel so bad any more. There are compensations for everything. In this case I can beat on the vfo and not change the frequency, so at least I know it was worthwhile!

The circuitry is quite conventional, but from a homebrewing standpoint can solve some very basic problems in getting a receiver or a sideband rig off the ground. The linear tuning is an awfully nice feature,

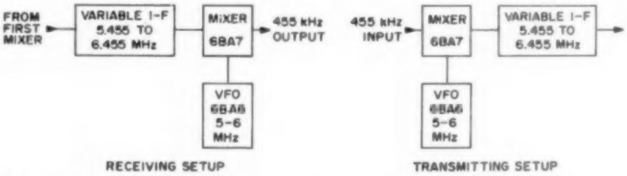

FROM FIRST MIXER
VARIABLE I-F 5.455 TO 6.455 MHz
MIXER 6BA7
455 kHz OUTPUT
VFO 6BA6 5-6 MHz
RECEIVING SETUP
455 kHz INPUT
MIXER 6BA7
VARIABLE I-F 5.455 TO 6.455 MHz
VFO 6BA6 5-6 MHz
TRANSMITTING SETUP

Fig. 1. Using the vfo and tracking mixer for receiving or transmitting requires only reversing the input and output connections to the mixer.

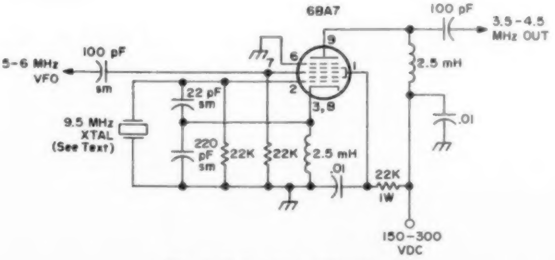
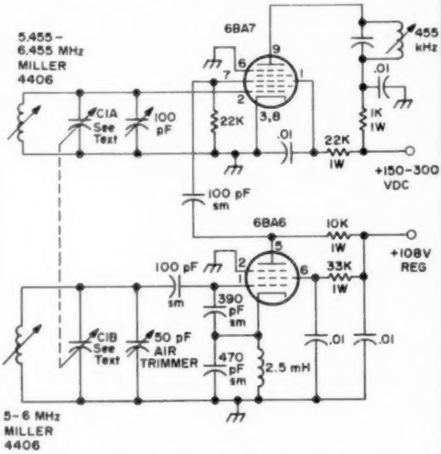

6BA7
100 pF
3.5-4.5 MHz OUT
5-6 MHz VFO
100 pF
sm
9
6
7
1
2
3,8
22 pF sm
2.5 mH
.01
9.5 MHz XTAL (See Text)
220 pF sm
22K
22K
2.5 mH
.01
22K 1W
150-300 VDC

Fig. 2. Setup for calibration.

which is easier to come by than you might imagine. Obviously, the answer lies in the tuning capacitor. The one I used came out of an old Gonset 3–30 MHz converter. If I'm not mistaken, most of the old Gonsets used virtually the same capacitor, and they can be picked up for about $5, which gets you not only a first-class two-gang variable that's built solid, but a nice assortment of parts and a dandy little box for your next transistor QRP transceiver! These capacitors have about a 60:1 reduction train built right in, consisting of a miniature planetary vernier and a nice smooth gear drive. You'll find it's very smooth tuning with no discernible backlash, and it has all the


5.455 - 6.455 MHz MILLER 4406
6BA7
9
6
7
1
2
3,8
455 kHz
.01
CIA See Text
100 pF
22K
IK IW
.01
22K IW
+150-300 VDC
100 pF sm
6BA6
10K IW
+108V REG
100 pF sm
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1
5
6
33K IW
390 pF sm
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Fig. 3. The complete circuit, set up for receiving.

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The capacitance of the particular unit I used appeared to be about 200 pF per gang. These capacitors are quite linear in the middle two thirds of their range, and adding a stop to prevent travel into the nonlinear areas is quite simple. The rotor plates are stabilized by two brass plates. All that is required is to solder a piece of 12-gage wire between the brass plates and you have a simple and positive stop against the frame. At this point, you should build the vfo section of the circuit. You'll find that it tunes about 3 MHz around the required frequency. This means that plates have to be removed. I'm not 100% sure that the capacitor you get from your old Gonset is going to be identical to mine, but in my case I had to remove all but three rotor plates to get the tuning range down to 1 MHz. I suggest that you do not remove all but three rotor plates before checking this out plate by plate as you remove them.

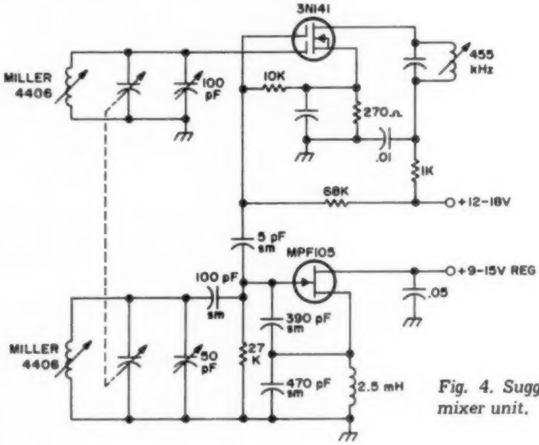

Fig. 4. Suggested solid-state version of the vfo–mixer unit.

Figure 2 shows the setup I used to calibrate the vfo. If the receiver you're using has only a 500 kHz tuning range, you'll have to use a 9 MHz crystal to calibrate the upper half of the tuning range. Before you start, be sure that the receiver and the vfo have both warmed up for at least one hour, and be sure that your receiver is zeroed with WWV. Now comes the fun of trying to make it linear within 2 kHz. It's not as bad as it sounds, so take heart and get to work. After you've finished with this, you'll have to adjust the tunable i-f for perfect tracking. By careful bending of the split rotor plates you can get near perfect linearity of the vfo range.

Now the mixer. If you're going to use the unit in a receiver, the tunable i-f tank feeds the first grid, and the 455 kHz i-f comes off the plate . . . vice versa if you're going to use it in a transmitter. Hook it up, be sure you've got the right image, and juggle L and C till it tracks the vfo. Nothing to it!

Once you've completed this unit, the hardest part of building a homebrew receiver or sideband rig is over. This comparatively foolproof circuit will serve as the heart of some very fine equipment. The linear tuning is a tremendous plus. If you want to get the jump on me, you might try using a FET for the vfo and a 3N141 dual insulated gate Mosfet for the mixer. There are many advantages to an arrangement like this, particularly in terms of spurious responses, since the 3N141 is a linear mixing device. Try the circuit of Fig. 4. It shouldn't be too far off the mark, although I haven't had a chance to play with it yet.

. . .W8RHR■

GENERAL CLASS LICENSE STUDY GUIDE

Part XII Some Final Touches

We've come a long way now, and here we are at the end of our study on the General class license exam. We've covered quite a few subjects, but several questions on the FCC study list haven't fit properly into any of our groupings yet – and so in this final discussion we will take up the "miscellaneous" points we've managed to ignore thus far.

These points range from considerations of operating courtesy to those involving FCC rules and regulations. The specific study list questions are:

4. List some operating procedures which can be employed to minimize interference and congestion of the amateur bands.

11. What is a third party agreement?

22. What is TVI? How can it be remedied if the amateur station is at fault? If the TV receiver is at fault?

39. Describe the transmission characteristics of the amateur bands below 30 MHz (Mc/s). List several propagation factors that influence signal transmission and reception in these bands.

While we'll try to follow our usual practice of broadening and paraphrasing the study-list questions with these final four, they are a bit more difficult to do so with than their predecessors, precisely because they are so miscellaneous in nature.

For this reason, we may not broaden them quite so readily as we did earlier subjects. This time, we'll ask first, "How do ham bands differ?" And we won't restrict ourselves to those below 30 MHz. Then we'll brush lightly across the subject of rules and regulations by inquiring, "What are some of the rules?" We won't go very deeply into this, because while theory remains relatively constant, rules are constantly changing and anything we say may become obsolete at any time.

Then we'll touch upon good-neighbor policies with that lament of a new licensee, "What can be done about TVI? And to wrap things up, we'll ask "How can hams improve their bands?" To answer this, we'll discuss general operating courtesies and requirements.

How Do Ham Bands Differ?

It takes only a receiver and a little listening to discover that each different ham band has a flavor all its own. That's one of the reasons why many hams settle down to operate on only one of the many available bands, and become known as "40-meter men" or "20 meter operators" or what have you.

One of the major factors contributing to this unique identity for each of our bands is that no two ham bands have identical transmission or propagation characteristics. Some are almost useless for short-range operation but perform spectacularly for long-distance contacts. Others are limited to line of sight. Operators who prefer DX gravitate to the DX bands, while those who just like to chew the rag tend to stick to short-range bands where they get a chance to become personally acquainted with their fellow ragchewers, as well as by radio.

Before we look in detail at the characteristics of each of the popular bands, let's see how radio waves in general are propagated. Earlier, we saw how waves are launched into space in all directions from an antenna, and are reflected from any large conducting surface. This is the heart of all radio propagation, and what makes the difference between one band and another is the difference in what will reflect the wave.

When radio waves leave the antenna, they go in all directions. Some travel directly to the receiving antenna without reflecting from anything on the way, and radio engineers call these the "direct wave" while hams usually call them the "ground wave." Some travel along the surface of the ground, if the radio frequency is low enough. Almost all the ham bands are high enough in frequency that this wave is ignored by hams; engineers call this the "ground wave" (which sometimes leads to confusion when hams and engineers talk with each other). Most signals, however, radiate out into space.

If conditions are right, some of this "space wave" will be reflected by ionized layers in the upper atmosphere, from 10 to 200 miles above the surface of the earth, and will return to earth at far distant points. These signals are known as "sky wave" signals since they appear to come from the sky (because of the reflection), and are the basis of almost all shortwave communication except for the line-of-sight "ground wave" operations conducted on low-frequency bands during daylight hours and on VHF bands around the clock.

The higher the frequency of the signal, the less effective will be this reflecting action. Balancing this, however, is the fact that other ionized layers tend to absorb lower-frequency signals, so that for any specific conditions in the ionosphere, both "lowest" and "highest" useful frequencies exist. The lower end of the range of useful frequencies provides shorter range, because the more effective reflecting action will permit the signal to go nearly straight up and bounce right back down. The upper end provides greater range, because only those signals which hit the ionized layers at a relatively shallow angle (which provides a longer "skip distance") can be reflected.

Figures 12-1 through 12-3 compare the different kinds of waves used by hams. Figure 12-1 shows the line-of-sight conditions for UHF operation. In this "direct wave" type of operation, the key factor is antenna height above ground. The higher the antenna, the greater the range – for exactly the same reason that you can see farther from the roof of a skyscraper than from ground level.

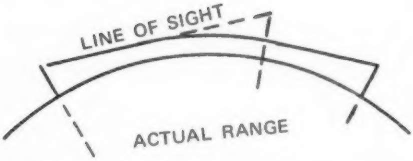

Fig. 12-1. Line-of-sight and horizon range of UHF radio waves are shown here. Curvature of earth has been exaggerated for emphasis. Key point is that antenna height above ground is virtually the only factor determining range of line-of-sight signals.

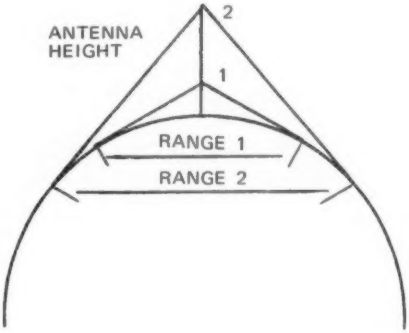

Fig. 12-2. Refraction of radio signals around earth's curvature as shown here extends line-of-sight distances in many cases. In almost all cases, actual effective range is same as it would be if earth's radius was 1/3 larger than it actually is. Weather conditions (tropo bending and "waveguide effect") can extend range amazingly at times. 2-meter transmissions from Hawaii to California have been accomplished by this method.

At all except the very highest radio frequencies, a bending of the radio waves around the curvature of the earth occurs as shown in Fig. 12-2. The waves are still direct waves, in that they do not reflect from anything, but they go a short distance past the visible horizon (about the same as if the earth's radius was 4/3 of its actual value).

Atmospheric effects can create "ducting" or a sort of waveguide action between the earth's surface and an air stratum, or between two different air strata, which gives the same sort of action as the refraction shown in Fig. 12-2 but actually depends upon reflection of the waves from the invisible "walls" of the waveguide. This type of action occurs reasonably frequently on VHF bands, where it is known as "tropospheric propagation" and leads to exciting DX.

The sky-wave propagation which accounts for the majority of ham long-distance operation is illustrated in Fig. 12-3. When a signal is propagated by the sky wave, it may leave the transmitting antenna at any angle from one which causes it to just graze the horizon, up to straight vertical.

A signal leaving the transmitting antenna vertically will return to earth very close to the originating station, which does not give exceptional range but makes possible good coverage of moderate-range areas.

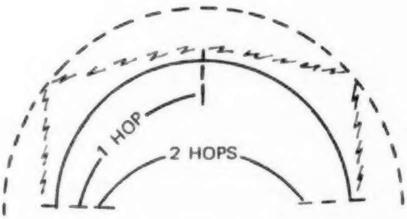

Fig. 12-3. Most ham DX depends upon reflection of radio signals from ionized layers in the upper atmosphere. This ionospheric reflection permits radio transmission from almost any point on earth to any other point, by proper choice of frequency and beam direction. Reflection is most effective in "HF" bands between 3 and 30 MHz, but sometimes occurs in 6-meter band as well.

One which leaves at the "grazing angle," however, gets the maximum range. It skims the surface of the earth at the horizon, then travels on until it hits the ionosphere at a distance from the transmitter somewhat greater than twice the distance to the horizon (because the reflecting layer is far above the surface of the earth), then is reflected at a shallow angle, and travels an extended distance before returning to earth. When it returns to the surface, it may be reflected back up for another hop, or may graze the surface and thus begin a second hop without surface reflection. Multiple-hop transmission makes it possible to reach almost any spot on the planet from any other spot by proper choice of frequency to suit the prevailing ionospheric conditions.

At least four different layers in the ionosphere (Fig. 12-4) have been identified. They are identified by letters. The D layer is the lowest of those which seriously affect ham radio signals. It's about 35 miles above the surface of the earth, and absorbs low-frequency signals somewhat like the way in which fog swallows up light. The D layer is present only during daylight hours, and makes the lower-frequency ham bands almost useless for sky-wave propagation in the daytime.

Some 25 miles above the D layer is the E layer, which is also present only during daylight (but during the winter, it may persist for several hours after sunset). This layer reflects signals which reach it, and causes "short skip." "Sporadic E" clouds are patches of extremely dense ionization within the E layer which are capable of reflecting VHF signals, and provide skip signals on 6 meters (and on rare occasions, on 2 meters as well).

Far above the E layer, at an altitude of about 120 miles, is the lower of the two F layers, called F1 to distinguish it from the 200-mile-high F2 layer. Like D and E, Fl is present only during daylight and for a short time after sunset. This layer reflects signals at higher frequency than does the E layer, and provides the majority of the intercontinental DX worked by hams during daylight.

At night, the F1 layer either vanishes or rises to merge with the F2 layer above it. This uppermost of the reflecting layers provides the longest range for signals, but is less effective at higher frequencies than are the lower E and F1 layers.

Both the frequency limits and the altitudes of these layers are influenced by the intensity of the ionization, which in turn depends upon many things. The major factor affecting the ionosphere is solar activity. During years of high activity on the part of the sun (sunspot maxima), ionization is more intense and the maximum usable frequencies are higher, than in years of low solar activity. The seasonal variation between winter and summer performance is due to the change in the angle at which solar radiation reaches the earth, which affects the height of the layers. For serious DXers, intense study of the ionosphere is indicated.

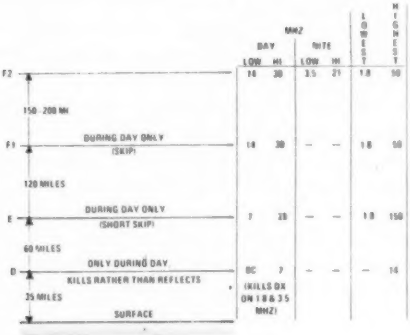

Fig. 12-4. Various layers of ionosphere and their characteristics are shown here. Both the upper and lower frequency limits for each layer, day and night, are listed. Seasonal variations also occur, and entire range is shifted by the 11-year sunspot cycle. These variations are shown as "lowest" and "highest" columns in listing.

Because of all the variable factors affecting the ionosphere and thus changing the way in which signals are reflected, any generalizations about the various ham bands' typical characteristics must be subject to rather large amounts of error. The following summary is intended to portray "typical" conditions which, unfortunately, are hardly ever met in actual practice.

The lowest frequency ham band, 160 meters, has only limited usefulness for any purpose during daylight because of the strong absorption by the D layer. Even at night when the D layer is no longer present, range of "top band" operations is limited, but transoceanic DX has been achieved and many operators take a special interest in activity on this band, traditionally the oldest of them all (because original ham activity was restricted to shortwaves, and these wavelengths are the longest of the original ham region).

The next higher ham band, from 3.5 to 4.0 MHz, is known as 80 meters to CW and novice operators and as 75 meters to phone enthusiasts. It is one of the most popular bands for domestic activity. During the day its range is restricted by D-layer absorption, but this restriction usually vanishes near sunset and the band then opens up to permit transcontinental contacts, with little or no "dead zone" between. It could easily be possible to assemble a roundtable network on 75 or 80 meters with stations from every one of the 48 contiguous states, with every station hearing each of the others, were it not for the congestion due to the band's popularity.

Above 75 meters, the next ham band is 40 meters. This band sometimes suffers from D-layer range restrictions during daylight, but even during the day ranges up to 1000 miles or so are not uncommon. The maximum usable frequency at any time is usually well above 7.3 MHz, so that 40-meter signals may reflect nearly vertically from the E and F layers to provide good coverage of extended areas. At night, the band may open up for intercontinental operation, and nationwide night coverage here is the rule rather than the exception.

The 20-meter band, from 14 to 14.3 MHz, is traditionally the DX band. It is seldom used for domestic purposes, other than coast-to-coast contacts via single-hop F2 skip, but provides worldwide coverage capability day or night. Sometimes the maximum usable frequency (MUF) drops too low at night to permit use of 20 meters, but this occurs only near the periods of minimum solar activity. At most times, this band is always open to somewhere far away.

On 15 meters, DX is also the normal condition,but by this time we are into the upper frequency region (above 21 MHz) where sky-wave operation is not always possible. When the ionosphere will not reflect 15-meter signals, this band is virtually dead. On the other hand, when the band is open it frequently offers a longer operating range (more distant DX) than does 20.

The 10-meter band, from 28 to 29.7 MHz, is like 15 only more so. During sunspot maxima, the band is often open round the clock, and intercontinental contacts are there for the working. For a large part of the time, though, the band is dead and is used only for local mobile operation such as is found in the VHF region.

The 10-meter band is the upper limit of HF ham bands; the boundary between HF and VHF lies at 30 MHz. The lowest VHF ham band is 6 meters (50–54 MHz), just below TV channel 2 in the spectrum. This band is an experimenter's delight, because unusual propagation techniques such as scatter, tropo propagation, etc. become easy to handle at this frequency. Normal sky-wave operation so common to "dc bands" (the VHF operators' derisive label for the HF region) is rare on 6 meters; sporadic-E brings 1500-mile ranges occasionally, and about one year out of eleven at sunspot maximum the F2 reflecting capability may climb up to the lower part of this band, but for the rest of the time most use of this band is for local communication and mobile operators.

The 2-meter band is like 6 only more so, somewhat as 10-meter operation resembles that on 15. Sky-wave propagation is almost unknown at 2 meters and above, but the exotic propagation techniques such as meteor trail reflection, moonbounce, and satellite relay begin to become practical. The dedicated 2-meter operator usually concentrates on this type of operation, while the casual user and the public-service-oriented operator make use of mobile installations and FM repeaters.

The uppermost VHF ham band is 220 MHz or 1¼ meters. Its characteristics are very similar to those of 2 meters, but because of the increased difficulty in making circuits operate easily this band is not so popular with most operators. It may be lost ere long because of its relative unpopularity, as was the old 11-meter band.

What Are Some of the Rules?

The final authority concerning what a licensed ham may and may not do with his station is Part 97, FCC Rules and Regula-

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- how to keep a repeater on the air
- how to determine a prospective repeater's range
- how to get your repeater license

The Handbook contains 208 pages of useful, hard-to-come-by information, and it's written in an interesting, personal vein by Ken W. Sessions, Jr. (K6MVH) former editor of FM Journal, now managing editor of 73.

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tions, published by the Government Printing Office and available from the Superintendent of Documents. Every ham or would-be ham should have an up-to-date copy, but the sad fact is that few really do.

The pertinent portions of Part 97 are published as a part of the ARRL's license manual, and since the license manual costs only a fraction of what the real rule-book will set you back, most hams simply keep a relatively recent copy of this around to satisfy the requirement that they must know enough about the rules to follow them at all times.

The rules themselves divide into several categories. Some govern the physical characteristics of an amateur station; this is particularly directed at antenna height, and the idea is to be certain that no ham antenna is high enough to be a menace to airplanes. At this writing, the limit was 170 ft, or 1 ft above ground for every 200 ft range from an airport, whichever is less. Exceptions may be granted upon written application, which means in effect that if it's all right with the FAA, it suits the FCC also. Also in this group are the rules which require every amateur station to have a "fixed" transmitter location, which means a mailing address at which the licensee can always be reached.

Another group of regulations within Part 97 establishes technical standards for amateur stations. These rules establish the authorized frequencies for each class of licenses, the power limits, the type of signals permitted, and the quality of signals required.

A third category of the rules sets up operating requirements and practices required of all licensees. One key point which the FCC has always felt it necessary to explicitly state, and which many hams often violate, is that in all situations not specifically covered by these regulations, each amateur station shall be operated "in accordance with good engineering and good amateur practice."

Among the rules in this category are those requiring a licensed amateur to control the station at all times when it is operating, prescribing the method for identifying the stations in a conversation, permitting certain kinds of one-way transmissions, and detailing procedures for portable and mobile operation. Log-keeping and emergency operation are also covered in this section, as are "permissible communications."

Not all the "permissible communications" rules binding the U.S. ham are listed in Part 97, however. International regulations also apply, and these international regulations restrict the kind of communication permissible between two amateur stations to "messages of a technical nature relating to tests" being carried out, and "remarks of a personal character for which, by reason of their unimportance, recourse to the public" communication services is not justified. They continue to spell out that it is "absolutely forbidden" for amateur stations to be used for transmitting international communications on behalf of "third parties" (meaning someone other than the two hams involved in the contact). The term "third party traffic" has come to signify this "absolutely forbidden" type of message.

What makes third party traffic legal at all is the fact that it is not forbidden in domestic communication, only internationally; and even in international situations, the prohibition "may be modified by special arrangements between the administrations of the countries concerned." The United States has made such special arrangements with a number of countries. The exact list of nations with which third-party traffic is legal varies from time to time, and may be obtained directly from the FCC.

The same international agreement also makes it illegal for hams of one country to contact those in any country which has filed formal objection to such international contacts. Several countries are currently on the forbidden list. Again, contact the FCC for the up-to-date listing.

Back to Part 97, a fourth category of FCC rules specifies "prohibited practices and administrative sanctions." Prohibited practices include broadcasting, accepting any form of compensation for use of a ham station, transmitting music or secret codes, use of "obscene, indecent, or profane" language or expressions on the air (which, like many present laws in this area, may not be enforceable, and which the FCC has indicated it will not enforce in all cases), transmitting false or unidentified signals, willful or malicious interference with any radio communications or signal (whether a legal signal or not), assisting anyone to obtain a license by fraud, and willful damage to any radio apparatus. If you get mad at your equipment, don't smash it.

Administrative sanctions include "quiet hours" or restricted operation, in case a specific ham is causing interference to other services. Several levels of restricted operation are prescribed; the most restrictive permits the ham to operate only between the hours of midnight and 8 a.m.

A fifth category of rules sets up the Radio Amateur Civil Emergency Service and governs its operation, while a sixth category prescribes requirements for ham station operation in this country by aliens who are licensed in their own countries. Only the first four categories are likely to be covered in detail on the General class exam.

Because the exact provisions of the rules are subject to change much more frequently than are the technical matters which we have been discussing in most of this course, we won't attempt to go into more detail concerning the rules. We recommend that you obtain a copy of Part 97 shortly before taking the exam, and studying the four categories of rules we've discussed here. Particular points to note are the frequency limits for the various classes of license and types of emissions, the corresponding power limits, and the section dealing with technical standards.

What Can Be Done About TVI?

Of all the "alphabet soup" combinations of initials which have hovered around our culture for the past 40 years or so, probably none has caused so much agony to so many hams as TVI.

Those three letters stand for television interference – specifically the type resulting from ham operation. In the early days of TV, TVI was the rule rather than

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the exception for an amateur station, and many hams simply shut down their operations for considerable periods of time until they learned how to overcome the problem.

They had good reason to do so, too. A woman scorned *may* equal the fury of a televiewer whose picture is suffering interference, but it would be difficult to convince those hardy hams who have faced both furies that the one resulting from TVI wasn't the worst of the pair.

History is full of instances of antennas being cut down, tires being slashed, antenna towers toppled, and hams being threatened with assault (and worse) because of TVI.

One factor which made the problem so difficult in the early days was that almost all early TV receivers used an i-f of 21 MHz, smack in the middle of one ham band, at the third harmonic of another, and the sixth harmonic of still a third band. In addition, the 6-meter ham band and TV channel 2 are adjacent to each other. No matter what band a ham used, he could hardly help getting into one of those old TV receivers. If he didn't make it in through the tuner, he would come in through the i-f section. On the rare occasions that both these failed, the audio sections would pick up his energy and detect it, and there he would be in the sound channel.

For several years, it seemed almost as if TV designers went out of their way to create the probability of ham interference. One ham thought he had escaped from TVI when he abandoned his favorite HF bands and went to 2 meters for all operation. He reasoned, correctly, that at this high frequency he couldn't possibly transmit any harmonics which could get into either the front end or the i-f of a TV receiver, and since he was an apartment dweller surrounded by televiewers this was important.

He learned, rapidly and to his utter dismay, that most of the TV sets in his apartment building were of a specific make and model which had the volume control on the front panel, and the audio section at the rear of the chassis, with a pair of 19 in. wires connecting the volume control to the audio section. As it happens, 19 in. is a quarterwavelength at 144 MHz; almost every one of his neighbors' TV sets had a very good quarter-wave whip antenna sucking in his 2-meter signal and spewing it into the audio section!

From experiences such as these, the subject of TVI gathered about itself a mystique and books full of exotic cures. One, for instance, which would cure such cases as the 19 in. leads (if you could convince the televiewer to do it), was to wrap the TV set completely in aluminum foil, and bond the foil to a water pipe. This made it a bit difficult to see the picture, but they solved that by putting screen wire over the picture tube face. Naturally enough, this approach did not prove popular with the public. They had spent much money for those sets, and obviously it had to be the hams who were at fault.

Not all the complaints were so serious, though. Occasionally a viewer would call a ham to mention that he was hearing the ham's side of the conversation, and far from complaining, was interested enough to want to hear the rest of the conversation as well. This offered a source of new converts to ham radio – and it was sorely needed in those trying times.

Along the way, of course, those hams who stuck to it managed to learn how to clean up their transmitters and receivers (yes, even receivers created TVI) so that the only troubles left were due to faults in the TV sets themselves (and in the whole nature of radio – a class of problem exists which just happens, and we'll get to it shortly). These lessons were passed on through the ham magazines and by discussions, reaching the designers of commercial ham equipment, and the status of being "TVI-proofed" rapidly became a key sales feature for a commercial rig.

What really made the problem manageable, though, was the TV industry's realization (with a bit of government prodding) that it wasn't really good engineering to select ham bands for the i-f, and the subsequent switch to 41 MHz as a standard i-f for TV receivers. Once the obsolete sets with 21 MHz i-f strips became extinct, the number of TVI complaints dropped noticeably. And the existence of TVI became a sales pitch for pushing those new TV designs as well.

Nevertheless, the problem is still with us (although at reduced magnitude), and probably always will be. So, for that matter, is the inverse problem – interference to ham stations by TV receivers. The 15–750 kHz horizontal sweep frequency of a TV set is rich in harmonics, and on occasion makes the lower frequency ham bands unusable. Here, however, we'll concentrate on TVI rather than ITV (interference by television).

A TVI problem normally will fall into one of three categories. Either the ham station is at fault, the TV receiver is to blame, or it's the result of a law of nature about which no one can do anything.

Faults at the ham station usually boil down to the fact that the transmitter is letting unwanted harmonic energy get out, and some of this energy falls within the TV channel someone wants to watch.

The cure for this class of problem is to prevent the transmitter from letting the unwanted harmonics out. Careful tuning and operation can reduce the amount of harmonic energy generated, but a certain unavoidable percentage of harmonics are inevitable when class c amplifiers are used. A single-band antenna rather than a multiband design can help prevent the radiation of harmonics, but the accepted cure for the problem is installation of a low-pass or "TVI" filter in the feedline between transmitter and antenna. This filter will have little effect upon normal transmitter operation, assuming that the feedline is matched so that the filter sees its design impedance levels at input and output, but will block the path for the higher frequency interference-creating harmonics. Figure 12-5 shows the hookup.

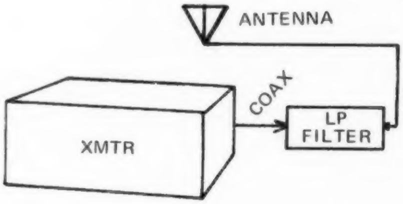

Fig. 12-5. Low-pass filter connected between transmitter and antenna as shown will help control TVI if harmonics are getting out through feedline. For this to be effective, transmitter itself must be properly shielded and all power and control leads filtered, so that no harmonic energy can escape except through the feedline. Antenna tuner serves just as well as does special TVI filter, and also permits accurate matching to antenna.

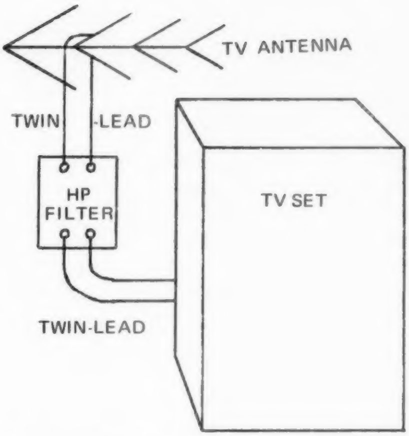

Fig. 12-6. When ham station is operating properly and TVI is due to TV set's failure to reject ham signals, a high-pass or TVI filter between the TV antenna and TV receiver as shown here may prove helpful. Most TV manufacturers will provide such filters free of charge upon request by the TV set owner, in compliance with FCC requirements that sets not be capable of radiating energy (the filters serve to prevent radiation of signals from the set, as well as reception of undesired signals by the set).

Faults at the TV receiver may be insufficient selectivity, which permits the ham signal to get into the receiver front end despite the wide difference in frequency and thus overload the set, or inadequate shielding, which may lead to the audio pickup problem mentioned earlier.

If the trouble is due to the ham signal getting in through the front end, a high-pass filter in the feedline may help. This won't affect the high-frequency TV signal but will cut back on the amount of ham signal which gets through. Figure 12-6 shows how such a filter is installed. In weak-signal areas, it may be possible to readjust the TV antenna to put the ham station's signal in a null without significantly reducing the signal from the TV station, also.

If audio pickup is creating the problem, the surgery indicated by Fig. 12-7 is an almost-guaranteed cure. This may be applied to any kind of audio equipment which is bothered by ham interference, such as BC radios, record players, tape units, and so forth. It simply prevents the ham signal from being detected by the audio stage, without harming the normal function of the audio stage.

The most difficult class of problem to deal with is that which is nobody's fault. The most common such problem is one in which two radio signals, each faultless in itself, mix in some accidental circuit (such as a corroded rain gutter or a rusty metal fence) to create either a sum or a difference product which comes out in a valid TV channel and causes interference. Sometimes one of the original signals is itself a TV signal.

For instance, if a city has stations on channels 4 and 13, it's easy for a ham operating on 144 MHz or a frequency close to 144 to create interference through no fault of his own. This comes about because TV channels 4 and 13 are exactly 144 MHz apart, and the ham's 144 MHz signal can mix with the channel 4 signal to produce interference on 13, and at the same time mix with the channel 13 signal to produce interference on 4. While all this is going on, the two TV signals are mixing and wiping out the ham's receiver on 144 MHz.

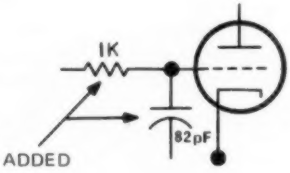

Fig. 12-7. Most cases of audio interference to TV by hams involve detection of the ham signal by the audio circuits of the receiver. This type of interference can also attack hi-fi installations, BC radios, and other entertainment devices. It is almost always due to faulty design of the affected device. Addition of an rf filter composed of a resistor and capacitor as shown here will cure it. Never make the change yourself, though; insist that the work be done by a professional service technician unless you want to be blamed for everything that ever may go wrong with the set after the filter is installed.

When this happens, you can do only one thing: find a new operating frequency which does not cause interference. There are just too many possible sources of mixing action to hope to track them all down, and even if you could, new ones would develop naturally within a few days.

Most cases of TVI, however, do not involve this kind of mixing. The majority result from improperly operated ham transmitters, and misused TV receivers. Usually, tact and diplomacy rather than technical knowledge are the cure to the complaint, but it always helps to be able to show your own TV sitting alongside your station, operating perfectly, to convince the complainer that you aren't deliberately upsetting his reception and that possibly his own set may be contributing to the problem.

How Can Hams Improve Their Bands?

Interference and congestion are the hallmarks of the amateur bands, which has suffered an overpopulation problem since long before the population explosion became a popular worry.

The cause of the problem is painfully obvious: Several tens of thousands of hams over the world, at any one instant, are attempting to all operate in a segment of the rf spectrum which totals less than 4 MHz, and which furthermore is split up into many smaller sections.

Not all of these small sections are overpopulated. For instance, while the 75-meter phone band may be a mass of interference from one end to the other on a winter weekend night, it's quite likely that the CW portion of 80 meters may be almost vacant at the same time.

Similarly, the low end or "rare DX" region of the 20-meter CW subband may be a howling cacophony of QRM, while only a few dozen kilohertz away from the pileup, vacant space goes begging.

One cure for congestion would be unpopular, but has been seriously suggested by some hams – that is, to limit the amateur population. This may, in fact, have been partially behind the incentive-licensing proposals which raised such a furor in ham ranks. It's certain that at least some hams quit in disgust over the issue, but it's doubtful that the net ham population suffered any loss because of continual infusions of new amateurs.

Short of an actual restriction upon numbers of hams, about the only practical solution to the problem is for all operators to adopt procedures which tend to minimize congestion and interference.

Among these procedures are the elimination of unnecessary on-the-air testing, keeping contacts on crowded bands brief, and listening more than you transmit.

Some on-the-air testing is, of course, necessary. You can't tell how a new antenna is going to load without loading it, for instance, and it's difficult to check the efficiency of a TVI-proofing operation unless you put the transmitter on the air and see whether its TVI is eliminated.

But there's no need to perform such tests as these at the times when the band is most crowded. Most on-the-air testing is of a nature which can be done almost any time, and if it's done when the band is relatively unused it obviously won't interfere with as many communications as it would if performed when the band was at its most crowded level.

Along with unnecessary on-the-air tests during crowded operating hours, long-winded CQs can be done away with. Inexperienced operators in particular tend to call CQ for hours on end, without stopping to find out if anyone is answering. While there's no officially recognized record, the fellow who sent nothing but "CQ" for 15 minutes without a break undoubtedly was a contender for it – not to mention being a rule violator, because the rules require that the transmitting station be identified at least once every 10 minutes.

Normally, a "3 by 3" CQ is adequate for the purpose. A "3 by 3" from W2NSD/1, for instance, would be: "CQ CQ

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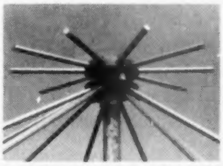

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CQ de W2NSD/1, CQ CQ CQ de W2NSD/1, CQ CQ CQ de W2NSD/1." Then pause and tune the band to see if anyone is answering. Since an answer may show up anywhere on the band, it will take much longer to tune for a possible reply than it took to send the call, and so the transmitting/receiving time ratio will go down for each operator – which reduces band congestion.

Keeping contacts brief is a rule of life for DX operators, who are trying to make as many contacts as possible in a limited time. Even for a ragchewer who enjoys conversation for its quality rather than its quantity, though, there's no need to spend all night saying "uhhhh . . . " into the mike. During contests or other periods of high activity, when bands are at their most crowded, the ragchewer might do well to avoid the crowded parts of the bands and wait until later to visit. This will preserve not only the tempers of the other operators, but that of the ragchewer as well, because he won't be continually plagued with interference drowning out part of his contact.

This is not an argument against chewing the rag, because that can be one of the most satisfying aspects of ham radio for those who enjoy conversation. It's merely recognition that there's a time and a place for everything, and a crowded expressway is no place to pull up alongside an old friend, stop, and visit. When expressway conditions prevail on the bands, visiting can move to less crowded regions, and return when the traffic is less dense.

Technically adequate equipment, operated properly, is necessary to reduce congestion. An overmodulated phone rig, whether AM, FM, or SSB, can interfere with every contact on an entire band. This, however, is not so much an operating practice as it is a question of meeting the required technical standards (most of which are intended to reduce interference to a minimum).

Proper choice of the type of modulation to suit the purpose of the contact can go a long way toward reducing interference. A CW signal takes up only about 1/600 the bandwidth of an AM phone signal, so for contacts which can be adequately handled by CW, it would be the proper choice from an interference standpoint. RTTY compares favorably to CW in its bandwidth requirement.

Another operating practice which reduces congestion is that of adopting operating standards, then adhering to them. For instance, on a traffic net many operating conventions are established in order to minimize the number of times a message (or part of a message) must be repeated. When the same message is going to several addressees, the text may be sent only once. Conventions of this sort help reduce the amount of time any one station is on the air, which in turn reduces congestion and interference.

Interference can be minimized by "channelizing" operation, and there has been some movement towards doing so on a voluntary basis on some bands. This means that an operator on such a band uses only one of the "channel" frequencies, rather than using a frequency between channels. When the channel frequencies are properly chosen to suit the type of modulation in use, no transmission on any channel will interfere with any signal on any other channel. The only interference then comes from other stations on the same channel, and from those individualists who persist in using the spots between channels. The fellows "in the cracks," however, interfere with not one but two channels, and receive interference from both as well, which tends to discourage them from staying there.

The most important single rule to reduce interference and congestion, though, is one which is not limited to radio. It was enunciated many years before radio was invented, and reads: *Do unto others as you would be done unto.* Any operator who follows this rule, in all cases, should find few problems with interference – and if we all followed it, the interference and congestion problems which have plagued ham bands from the beginning would disappear.

. . . Staff ■

EFFECTIVE HEATSINKING FOR SUCCESSFUL SOLID-STATE DESIGN

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4261 46th Ave. North
Robbinsdale MN 55422

Why does a 100W transistor "blow" when dissipating only 25W? How much heatsink is required for a particular application? Questions like these stop most hams dead in their tracks. The purpose of this article is to give some insight into the thermal considerations of transistors.

The critical thing regarding power dissipation in transistors is the temperature of the collector-base junction. All transistors have a maximum allowable junction temperature, usually in the range of 85–100 °C for germanium units and 175–200 °C for silicon. The operating junction temperature is determined by the ambient temperature, the thermal resistance from the junction to the ambient, and the power the junction is dissipating, or converting to heat. The entire thermal situation is most easily understood by use of an analagous electrical circuit. The thermal parameters and their electrical equivalents are shown in Table I. The circuit is shown in Fig. 1.

Table I. Thermal and Electrical Equivalents

ELECTRICAL		THERMAL	
PARAMETER	UNITS	PARAMETER	UNITS
voltage (E)	volts (V)	temperature (T)	degrees (C)
current (I)	amps (A)	power (P)	watts (W)
resistance (R)	ohms (Ω)	thermal resistance θ	degrees C watt (C/W)

A current source represents the power being dissipated by the transistor and a battery represents the ambient temperature. The thermal resistance from junction to ambient is shown as three resistors in series; the junction-to-case resistance θ_{JC}, the case-to-heatsink resistance θ_{CS}, and the heatsink-to-ambient-resistance θ_{CA}. The voltages at the various circuit nodes represent the ambient temperature T_A, the heatsink temperature T_S, the transistor case temperature T_C, and the junction temperature T_J. The junction temperature is the product of the power and total thermal resistance plus the ambient temperature.

$$T_J = P \times (\theta_{JC} + \theta_{CS} + \theta_{SA}) + T_A$$

Thus, the maximum allowable power dissipation is:

$$P_{MAX} = \frac{T_{JMAX} - T_A}{\theta_{JC} + \theta_{CS} + \theta_{SA}}$$

In the case of transistors operated without a heatsink the three resistors may be lumped into one, θ_{JA}, the thermal resistance from junction to ambient. Then the equations become:

$$T_J = P \times \theta_{JA} + T_A$$

$$P_{MAX} = \frac{T_{JMAX} - T_A}{\theta_{JA}}$$

At this point it becomes obvious that the power rating of a transistor is a function of ambient temperature. The hotter the transistor's environment, the less power it can handle, because the junction must be kept below a certain temperature. Transistor power ratings are generally given for a case temperature of 25 °C (normal room temperature). Thus, a 100W transistor can handle 100W only if the case temperature is held to a maximum of 25 °C. Referring to Fig. 1 we see that in order to accomplish this with an ambient temperature of 25 °C would require a thermal resistance from case to ambient of zero, in other words an infinitely large heatsink bonded perfectly to the transistor's case! If the total thermal resistance from junction to ambient was, say, 10 °C/W, the ambient temperature was 25 °C, and the transistor was dissipating 25W, the junction temperature would be:

$$T_J = 25\ ^\circ C + 25W \times 10\ ^\circ C/W$$

$$= 25\ ^\circ C + 250\ ^\circ C = 275\ ^\circ C$$

more than enough to blow any transistor!

So now we know why a 100W transistor can blow when dissipating only 25W. The next question is how do we find the values for the various thermal resistances and the maximum junction temperature so that we can calculate a more usable power rating.

Determining θ_{JC} and T_{JMAX} is easy, especially if you have a spec sheet for the transistor in question. The thermal resistance from junction to case may be given directly or as a derating factor of so many watts per °C of case temperature above 25 °C. These two figures are reciprocals – that is, dividing either of them into the number one gives the other. Thus, a derating factor of 0.5 W/°C implies a θ_{JC} of 2 °C/W. Maximum junction temperature may be given directly or as a maximum storage tempeature. That these two numbers are equal may be seen by considering Fig. 1 with zero power. Even if you only know that you have a bargain basement "200W germanium power transistor" you can still come up with reasonably accurate results by assuming a conservative T_{JMAX} and using the equation

$$\theta_{JC} = \frac{T_{JMAX} - 25}{P}$$

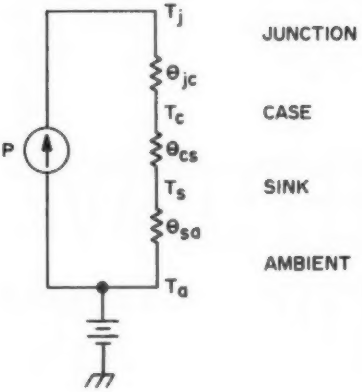


Fig. 1. Electrical circuit equivalent of heat dissipation problem.

For germanium transistor assume T_{JMAX} is 85 °C, giving:

$$\theta_{JC} = \frac{85 - 25}{P} = \frac{60}{P}\ ^\circ C/W$$

For silicon, use 150 for T_{JMAX}, giving;

$$\theta_{JC} = \frac{150 - 25}{P} = \frac{125}{P}\ ^\circ C/W$$

With this information we can calculate maximum allowable power dissipation for any given case temperature. Now we need to consider the thermal path from the transistor's case to the ambient air.

Referring to Fig. 1 we see that the path from case to ambient consists of θ_{CS} and θ_{SA}. The first term, θ_{CS}, depends on how well the sink is thermally coupled to the transistor's case. Typical values range from 1.5 to 0.1 °C/W, the higher value being for a "dry" mounting with a Teflon insulator and the lower value for a mounting with silicone grease and no insulator. The second term, θ_{SA}, is a function of the size and geometry of the heatsink. Here again, values may be obtained from manufacturer's specifications, and range from around 60 °C/W for clip-type radiators for TO-5 packages to 0.5 °C/W for 100 cu in. heatsinks for power transistors. A 10 in. plate of 3/32 aluminum has a thermal resistance of about 5.5 °C/W, while increasing the size to 80 sq in. reduces the value to about 2 °C/W. When no heatsink is used θ_{CS} and θ_{SA} combine to a single thermal resistance θ_{CA} which depends on the geometry of the case and is typically 150 °C/W for TO-5 packages and 35 °C/W for TO-3 packages.

At this point the whole subject may appear rather complicated! However, the basics are really quite simple once the circuit of Fig. 1 is understood. At any given ambient temperature the power handling capability of a transistor is determined by four factors; the maximum allowable junction temperature and three thermal resistances, one associated with the transistor's internal construction, one associated with the mounting hardware, and one associated with the heatsink. On some spec sheets one of the resistances may be ignored, assumed to be zero, or combined with one or both of the other two. In general, however, all three must be accounted for.

The biggest problem for the average ham is determining the effectiveness of homemade heatsinks. This is very easy to do *if you have a way to measure the transistor's case temperature.* This measurement may be made with any one of a number of instruments or chemical preparations, none of which is likely to be found in the hamshack. This "if" depends pretty much on who you know and what you can borrow. Assuming you can manage to get your hands on some such device, θ_{CA} may be determined by dividing the difference in case temperature and ambient temperature, in °C, by the power being dissipated by the transistor.

$$\theta_{CA} = \frac{T_C - T_A}{P}$$

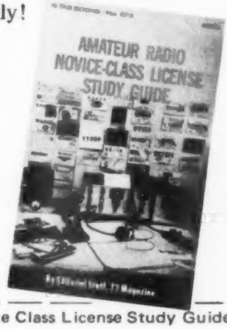
K5ZBA■

Subvert the Whole Family With Another New 73 Book

Accompanied by the applause of millions, the Amateur Radio Novice Class License Study Guide is out. Not previously published in the pages of 73, this brand new book really covers all the subjects relating not just to passing the FCC Novice exam, but to really learning all the necessary things for getting on the air.

Ham slang, FCC regulationese, simple formulas, and Novice theory are all explained and explained and explained. The book is absolutely crammed full of big, clear diagrams to explain the material step by step. After you've seen this book – and after you have really gotten your foundation in ham radio knowledge (or gotten the harmonics, XYL, or Aunt Harriet hooked on the hobby) – you'll wonder why some people just memorize answers to multiple choice questions when it is really so easy to understand the questions and answers and the theory behind them.

$3.95 buys you a softbound copy of this little gem. Buy one and convert the whole family!



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The Spider

Jack Townsend W4RIZ
124 S. Douglas
Wilson NC 27893

Anyone faced with the prospect of connecting a transceiver to a high-power final amplifier encounters interconnection problems. The Spider, an rf-actuated antenna relay, solves these difficulties.

The device performs three simultaneous functions: It switches the antenna from the transceiver output to the final amplifier output, switches the transceiver from the antenna to the grid of the final amplifier, and closes a set of auxiliary control contacts for any other exterior function.

Most transceiver owners are reluctant to dig into the control circuits of their equipment to bring out connections which can control an external power amplifier. To simplify the control considerations this device is designed to trigger on the rf output of the transceiver. Switching is accomplished by a direct-coupled transistor amplifier. A small capacitor couples rf into the amplifier at the moment the transceiver is energized, closing the relay. Whe the transceiver goes into receive mode the relay drops out, switching the system back to straight-through operation.

The "spider" pictured here was designed primarily for 2m operation, specifically to interconnect a 10W FM transceiver and a 300W power amplifier. The coupling capacitor which feeds rf into the transistorized relay amplifier has a value of 3 pF.

If lower frequency is desired it may be

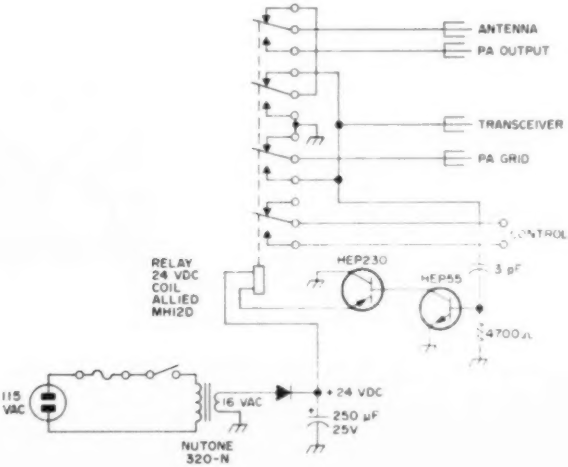


Fig. 1. Circuit diagram for the Spider.

necessary to use a larger value capacitor. To prevent overloading of the input transistor the smallest value possible should be used.

The relay is powered by a 24V supply. The transformer is available at hardware and electrical supply stores. Since it was intended for chimes and doorbells it may be left connected to the line on standby for an indefinite period.

The relay drive is a HEP 230 PNP power transistor and the input transistor is a low power HPH (HEP 55). The power transistor has its collector connected to ground so it may be bolted directly to the chassis.

The heart of the device is a 4 PDT relay with a 24V coil which may be selected to suit the convenience and pocketbook of the builder. Most surplus 24V aircraft relays pull in at 75–200 mA of current, which is within the ratings of the driver transistor The relay should be selected by the builder not only for the proper coil current, but for a contact arrangement which will not introduce too much unwanted inductance into the antenna circuit.

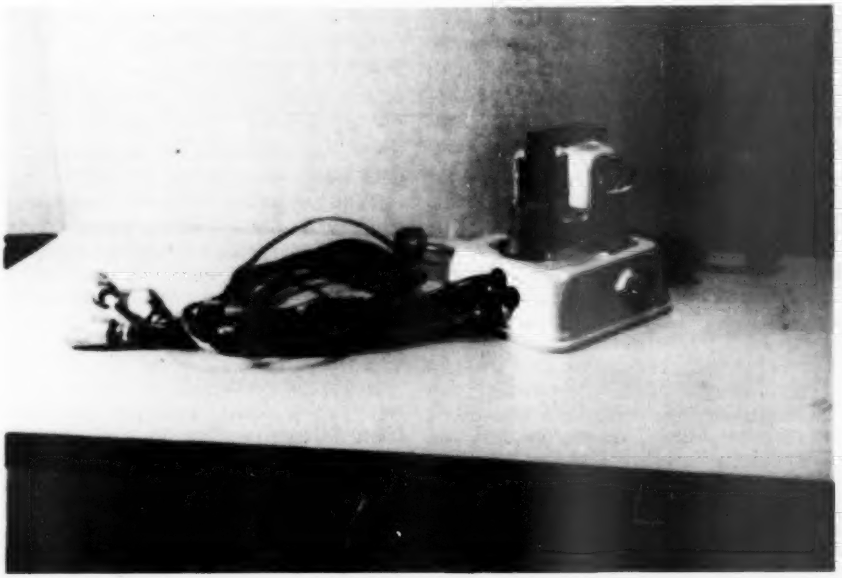
The relay chosen for my unit was selected for 2m operation. It is a sealed aircraft unit with contacts mounted on the headers spaced in a circle around the armature. Rf characteristics are good since contact length is short and a rotary action of the armature closes the contacts.

Four lengths of RG-58/U, each 20 in. long, are fitted with PL-259 connectors and the other ends brought into the chassis to the base of the relay. The braids are grounded to a U-shaped loop of 18-gage wire which is grounded on each side of the relay. Each cable should then be marked to identify its function.

The entire assembly was made on an aluminum freezer tray which is small enough to be tucked away into any convenient space betweeen equipment.

In operation the cables are connected but the final amplifier power supply is not turned on. When the transceiver is energized, a click should be heard in the relay, indicating that rf is triggering the relay drive properly. If the control contacts are then connected to the final amplifier power supply the device will activate the final at the same time switching is accomplished.

Note that rf does not flow in the



The completed Spider.

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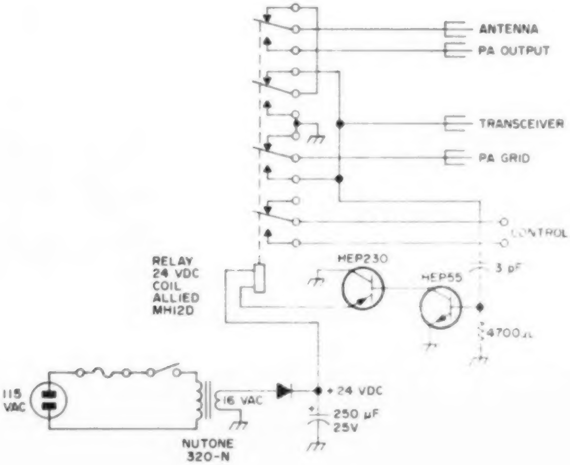

Fig. 1. Circuit diagram for the Spider.

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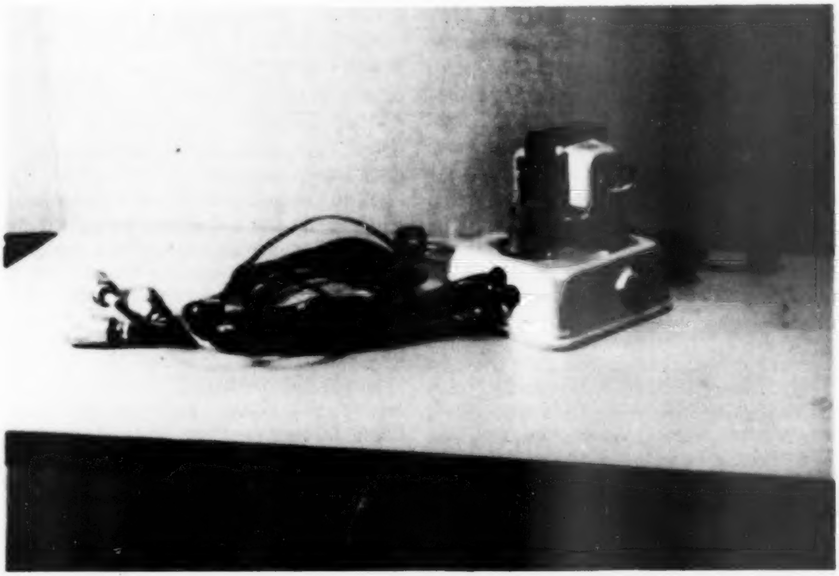
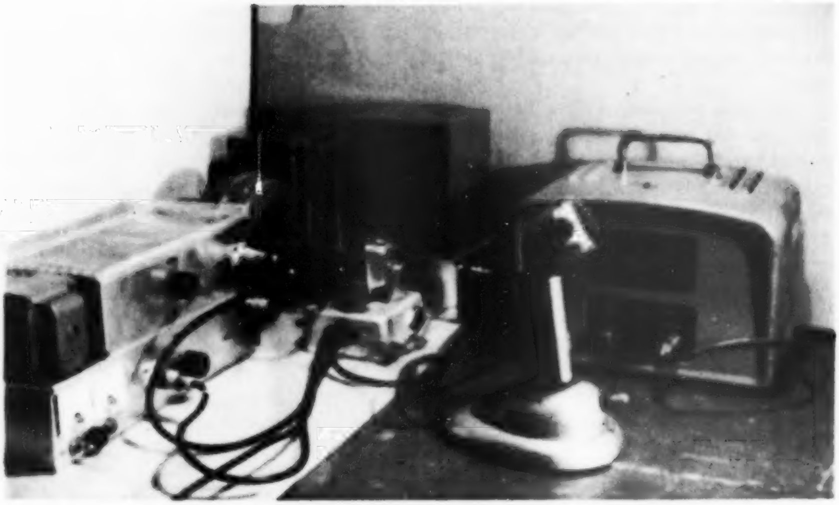


The completed Spider.



Spider connected to transceiver, power amplifier, and antenna. Auxiliary contacts on Spider key on power supply at rear.

contacts until after they are completely closed because of the slight time delay while the final amplifier power supply comes on. When dropping back to the receive mode, rf is removed before the contacts open. This design eliminates arcing and adds to the life of the relay contacts. To state it more simply, on transmit the rf precedes the plate current and on receive the rf goes off before the plate current.

In order to allow straight-through operation of the transceiver a power switch is provided on the chassis to turn off the 24V power supply. With the relay off, the transceiver works straight through to the antenna and the final amplifier power supply is not energized.

. . .W4RIZ■

Band Monitor For SB-300

Have you ever lost a call because you got tired of winding that band-switch back and forth across the band? Especially on the SB-300, where that great bandspread is something else again when it comes to finger fatigue after a few trips across that mammoth band. Here is a little modification that may prove helpful for listening for calls for which you perhaps know the approximate frequency, like tuning around for a net that may start any time, or listening for a ham friend who doesn't have the frequency accuracy you do.

This unit is most useful on the 6-meter band where the signals are (with converter) few and far between, and the one signal which will activate this device is most likely the one you want. It is also useful on the 80-meter band in the daytime for listening to that local who may call you anytime between 12:00 and 3:00 p.m.

The bandwidth of the SB-300 without the filters is about 130 kHz. Simply connect a high impedance monitor to the input to the crystal filters and use any type of indicating device you like, be it a light or bell.

The circuit should consist of a *rf* choke, a diode and an amplifier to operate a relay.

Anyone calling CQ, or your call, within 130 kHz of the setting you are on will activate your monitor. Then you must tune the band to find the absolute frequency of the calling station. Especially on the 6-meter band, if you have the converter, you can monitor the band all day, or at least 130 kHz of it, (and you probably know the normally used frequencies in your district) without that dreadful tuning.

David Collins, VE3GLX

Gilbert C. Ford W7OXD
1023 Ninth Ave. So.
Nampa ID 83651

"SAY COO, SAY COO DAY ECKEES"

OR SOME HAMS DON'T SPEAK ENGLISH

All Americans know that everyone in the world can speak English, or at least that's the way we act. Actually, English is the native language for less than 10% of Earth's people, and one expert has said that 2,795 other languages are currently used even in this day of vanishing cultural and language differences. Of course, English is a world language and is known and used to a greater or lesser extent as a second language by several million people in addition to those who claim it as their mother tongue. Furthermore, it is the *lingua franca* of many international activities including ham radio, but American hams are missing some great experiences by having to confine their DX QSOs to English.

DXing Without English

I grant that you can work 300 countries and use only English, but when the thrill of getting a 30-second contest-style DX contact begins to wane, you should consider the possibilities of ragchew-type DX QSOs with some of the countries that are easiest to work. We all remember unusual stories we have heard over the air. A VK telling you firsthand about the great rabbit fence across Australia or a Spaniard describing the castles in Castile makes for much more of an experience than the usual "UR 5 by 9 hr, bcnu" QSO. But when you start to ragchew with some foreign hams, you will find that their English which sounded so good while they were exchanging the usual QSO trivialities – QTH, signal reports, and handle – isn't adequate to carry on a conversation in depth. But see how the QSO will spring to life if you direct a few questions at them in their native language. You will soon discover that the castles of Spain sound even more romantic and exotic when described in Spanish. I remember several DX QSOs that had almost reached the 73 and BCNU stage when I switched to Spanish. Suddenly the operator on the other end came to life, warmth and excitement came into the QSO, and I had a memory to cherish.

How to Begin

All very well and good, you may say, but what can a ham do who doesn't know a foreign language?The answer is simple: learn one. Most Americans are convinced that learning another language is an impossibly difficult task, at least for Americans. It must be admitted that achieving the level of proficiency necessary to carry on a fluent, extemporaneous dialog on any subject in a second language is a challenging and lengthy task, but a much lower level of proficiency is sufficient to open new vistas for you in ham radio, vistas that you didn't even know existed. Don't be overawed by the task. After all, taxi drivers, bellhops, and porters in Europe can often use two or three languages well enough for their purposes. You may say, recalling the D you got in high-school French, that you have no ability with languages, but you did learn to speak your mother tongue fluently and what you did once, you can do again. An expert linguist once told me that studies have shown that the only prerequisite necessary to learn a second language is the desire to do so, and that those persons wanting to learn a language can, and those not wanting to, don't. It's that simple.

How should one begin? The first step is to choose a language. Concentrate on one, at least until you are well established with it. What language should you pick? This choice is largely a personal one, but I will make some suggestions based on my experience. First, don't select a rare, exotic language unless you have special reasons for your choice. You will not have much opportunity to use Telugu or Lesghian on the ham bands. Of course, if you already know a rare language or if you have personal reasons for wanting to talk with hams from Wales or Burma, then Welsh or Burmese may be the language for you. But the languages that a U.S. ham is most likely to use are Spanish, German, Japanese, and French, in that order. So pick your language and plunge in.

How can you best start? It may be a matter of resurrecting a language you studied in high school or college. Typically, most of us don't study a language in school with any actual expectation of ever really being able to use it, and many American foreign language teachers unfortunately share this lack of expectation. Most American students seem convinced that textbook Spanish or German is only that, that it could never actually be used, but those words and phrases you may have learned and forgotten are real and real people use them and will understand them. If you have had a year or two of a language, you have already made a good start. The way the language should be pronounced will quickly come back to you, and you may even remember a few words. In any case, you have a good base on which you can build.

DAS SCHWEIN!
11
12
13
14

"On the average you will have to meet a new word 14 times before it is yours."

Several ways for learning a new language are open to the neophyte and to the person with some experience. For self-study there are foreign language records and tapes. These are particularly helpful in learning correct pronunciation by imitation. And you should not overlook books. Although they will help you only in a limited way with pronunciation and conversation, no better or faster method than reading exists for increasing your vocabulary and for learning how a language is actually used. At first, reading in a foreign language will be painfully slow and not much fun. Eventually, you will notice that you don't have to look up the meanings of so many words, and wonder of wonders, the day will come when you will find that you are no longer translating but reading directly with understanding in your new language.

Be sure to start your reading with simple material. Don't be discouraged if you have to look up the same word several times before its meaning sticks. On the average, you will have to meet a new word 14 times before it's really yours. Graded readers based on very restricted vocabulary lists are readily available at any college or large general bookstore, and are most helpful in the beginning stages.

You will be more motivated and make better progress if you don't rush into advanced material too soon. However, once your reading ability has progressed sufficiently, do your reading from materials dealing directly with subjects that you expect to discuss. If you want to be able to talk about electronics, don't spend your time reading books on deep-sea fishing; read electronics. Arrange with a ham in a country using your new language to send you some ham magazines and electronics books, and then read and reread them. The reading will become easier and easier. Presently you will find that your dictionary isn't being used much. You can now deduce the meaning of most new words from the context in which they are used.

Learning to Speak

Although learning to read can be done by yourself, it is difficult to learn to handle conversation in a new language without help from another person. There are several approaches you should consider. Night classes in the conversational aspects of the common foreign languages are available through many colleges and universities. Another approach is to find a native speaker of your new language who would be willing to assist you. Often older persons who have time on their hands are more than glad to help, and you don't have to be able to visit them for every session.

OH WAD SOME POWER THE GIFTIE GIE US TO SEE OURSELS AS OTHERS SEE US

"Don't end up unknowingly imitating some dialectic form."

Telephones transmit other languages just as easily as they do English. One word of caution, however, don't end up unknowingly imitating some strongly dialectic form. There is an enormous difference, for example, between the German Schwabian dialect and standard German. You don't want to be disappointed by later learning that you have mastered some local dialect, something bearing the same sort of relation to your new language as Cockney does to standard English. If the person helping you has had a fair level of education in his native land, you are probably safe. But a little discreet investigation might enable you to avoid disappointment later.

On the Air

You need not wait until you have a high level of proficiency in your second language before trying it out on the air. If you are really timid about using it, CW is an easy way to begin. Call signs, RST reports, Q signals and the like will all be the same. In addition to these, all you will need is about a dozen previously prepared written sentences to make up the body of your QSO. If you can read your new language, you will have no trouble handling what your contact sends you. Have some questions ready to ask him, and hope that he doesn't ask you any, forcing you into making extemporaneous answers. But don't worry – he probably won't ask any questions. Most hams don't. So you probably won't have to improvise, but if you must, just do your best, and as a last resort you can lapse back into English. With a little experience your repertoire will grow, and you will begin to enjoy improvising answers and comments as you need them.

Now you are ready for phone. Instead of launching into a full-blown QSO, you will feel more at ease at first if you just use your new language for a few of the standard phrases used to close a QSO such as "Good luck, 73, I hope to talk with you again." Next, you might try a few sentences such as "I have studied a little Spanish and can speak it a little," or "I can read German, but cannot speak it very well." A sentence or two like that will usually result in your contact giving a whole paragraph of your new language back to you on his next transmission. You may get more than you can handle, but if you have warned him that you can speak only a little of his language, he will usually come back speaking slowly. If you do have trouble understanding, don't be afraid to ask him to repeat and to speak slowly and distinctly. At first don't try to use your new language when signal conditions are poor. With English you can easily fill in missed syllables and even whole words, but with another language you will need all the signal quality you can get; so wait for a time when signals are Q5.

I MUST CONTROL THE CONVERSATION!

"A conversation in a foreign language is much simpler for the beginner if he can control it."

A conversation in a foreign language is much simpler for the beginner if he can control it. By controlling the conversation, I mean that you determine the topics discussed and that you arrange the conversation so that the other person does most of the talking. The easiest way to accomplish this is to make your part of the conversation mostly questions which keep the other fellow so busy answering that he never thinks to ask you any. You probably cannot achieve complete control, but you will be surprised how easy it is to give the impression that you have perfected a language if you use this technique. It will also give you a feeling of security at first if your conversational partner does most of the talking, because your ability to understand your new language will always far outstrip your ability to speak it. Gradually your ability to speak will increase, and you can begin to relax your control over the conversation and give the other fellow a chance to ask some questions too.

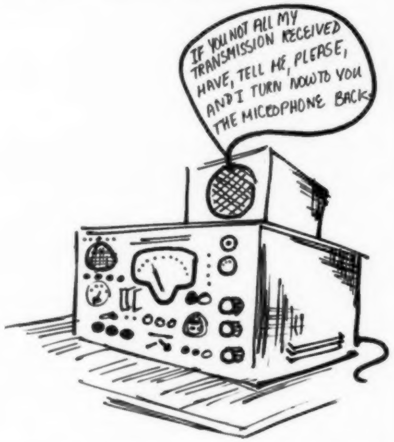
Learning Ham Jargon

You may need some help picking up the special ham expressions or jargon which are necessary for a QSO. You won't find them in standard language textbooks or dictionaries. Your best bet is to get a book giving ham expressions, such as *Ham's Interpreter*, published by DL1CU, Box 585, Stuttgart, or *Ham's Spanish-English Manual* published by August Gabriel, K4BZY, Fort Lauderdale, Florida. DL1CU's book covers ham expressions in French, Spanish, Italian, German, Swedish, Finnish, Serbo-Croatian (Yugoslavia), and Russian. By watching the ads in the ham mags you can probably discover some other similar aids.

A practical way to become familiar with these expressions is to use a tape recorder. Enlist the help of a native speaker in making a study tape. The best procedure is for you to read a sentence in English into the tape recorder, allow a pause of about two or three times longer than was required to read the English sentence, then have your friend read the equivalent sentence in Spanish, German, or whatever. Then go on to the next expression or sentence. For example:

I will send my card directly to you.
Pause, pause . . . . .pause.
Ich schicke Ihnen meine Karte direkt.

On playing back the tape, attempt to give the equivalent foreign language sentence immediately after hearing the English sentence. If you make a mistake, you will clearly recognize it on hearing the foreign language sentence. You will have in effect created for yourself a language laboratory setup with all its advantages – small easy steps, immediate reinforcement and feedback, and infinite patience.


IF YOU NOT ALL MY TRANSMISSION RECEIVED HAVE, TELL ME, PLEASE, AND I TURN NOW TO YOU THE MICROPHONE BACK

"People the world over find a foreign accent, if it isn't too bad, charming and intriguing."

Final Suggestions

When you are on the air, don't be afraid if you make a few mistakes. Your accent and intonation will probably immediately identify you as an American; but never mind, people the world over find a foreign accent (if it isn't too bad) charming and intriguing. Use a mixture of English and your new language if necessary, but try not to mix them within a single sentence, except possibly for an occasional word. Although FCC regulations require U.S. amateurs to use English in station identification procedures, you will find it most helpful to know well the alphabet and numbers in your new language.

Diligent effort is required to learn a new language, but the rewards are enormous. The combination of DX, ragchewing, plus the magic of a new language add up to many unforgettable experiences.

. . .W7OXD■

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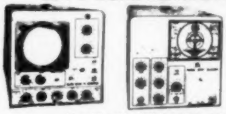

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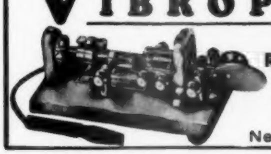

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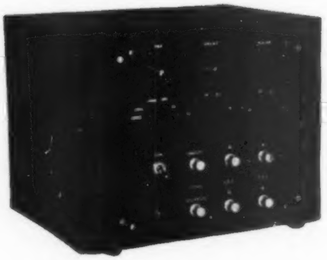


In designing an amateur pulse generator, the first consideration has to be compatibility with ICs. From the standpoint of convenience, economy, or versatility, it has become unattractive to build *anything* digital without IC logic. What this means to pulser design is that the pulser should be compatible with the types of digital ICs one finds himself using most.

Although RTL is the most widely used IC logic family in amateur circles, it is extremely doubtful whether this situation will last. The two types of "current-sinking" logic (DTL and TTL) are far out in front of RTL in industry usage and gaining daily. The reasons for industry preference of DTL and TTL over RTL are several: better noise immunity, higher speed, larger fanout, and a larger selection of devices around which to design.

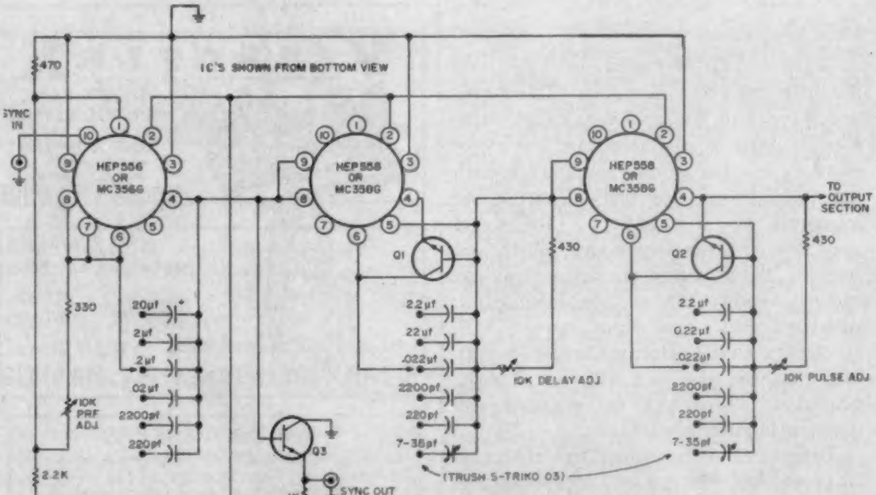

IC'S SHOWN FROM BOTTOM VIEW
470
SYNC IN
HEP556 OR MC3566
HEP558 OR MC3586
HEP558 OR MC3586
330
20µf
2µf
.2µf
.02µf
2200pf
220pf
10K PRF ADJ
2.2K
Q3
1K
SYNC OUT
-5.2V
Q1
2.2µf
.22µf
.022µf
2200pf
220pf
7-35pf
10K DELAY ADJ
430
Q2
2.2µf
0.22µf
.022µf
2200pf
220pf
7-35pf
10K PULSE ADJ
430
TO OUTPUT SECTION
(TRUSH S-TRIKO 03)
Q1,Q2,Q3 = 2N3646 OR MPS3646

Fig. 1. Pulse generator portion of IC pulser.

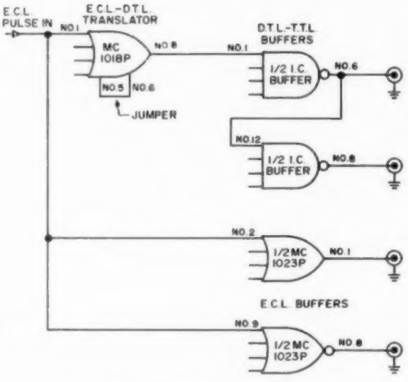


Fig. 2. Output section of pulser.

This pulser was designed so that its output would be compatible with DTL or TTL and also with ECL. The implementation of these two outputs is simplified by use of ICs that are designed for *buffer* and *clock driver* service. (The pulse generator section is shown in Fig. 1, and the output section in Fig. 2.)

The free-running multivibrator which determines the basic "rep" rate, the *delay* one-shot, and the *pulse length* one-shot use HEP versions of MECL ICs. The entire basic pulse-forming system is similar to that of my previous article (*Pulse Generator for the Amateur*, 73, Nov 1967). A number of improvements have been made, however.

By using an etched circuit board, it is possible to reduce lead lengths and get shorter pulses. Longer pulses are also provided by extending the range at the other end of the range switches. An additional transistor has been added to both the *delay* and the *pulse length* one-shot. These transistors allow the one-shots to recover more quickly, providing more stable operation for pulse lengths approaching the period of the basic rep rate.

Since one of the two outputs is to be ECL-compatible, the basic pulse-forming section is powered from −5.2V. This means that V_{ee} (terminal 2 of the HEP 556 and 558s) is connected to −5.2V, and V_{cc} (terminal 3) is connected to ground.

The DTL–TTL portion of the pulser, of course, requires +5V, which is also provided. By carefully arranging the pin numbers of the 14-pin socket, any one of three different families of logic may be used in the DTL–TTL buffer position. The least expensive is the DTL buffer (MC832P). The SN7440N is a TTL buffer that is compatible pin-for-pin. And it can also be used at a slightly higher cost. The MC3025P, member of a different TTL line (MTTL III), can also be plugged in. The cost of the MC3025P is a bit higher than the SN7440N; each step up in cost corresponds to an increase in speed. For two of the types of buffers mentioned above, there are numerous replacements made by different semiconductor manufacturers. These are listed in Table I; they are *not* different families, but rather second-source items.

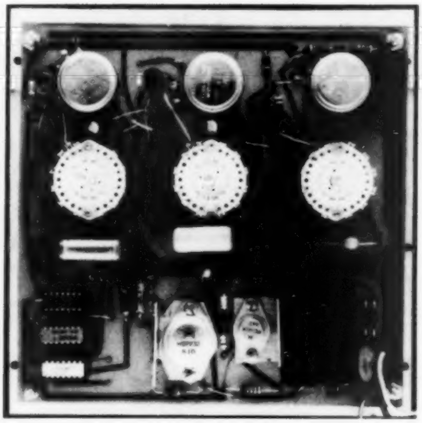
Table I.

Specified Type	Manufacturer	Equivalent	
SN7440N	Texas Inst.	DM 8040N	National Semiconductor
SN7440N	Texas Inst.	USN 7440A	Sprague
SN7440N	Texas Inst.	N 7440A	Signetics
SN7440N	Texas Inst.	FJH 141	Amperex
SN7440N	Texas Inst.	MC7440P	Motorola
MC 832P	Motorola	DT μL 932	Fairchild
MC 832P	Motorola	SW932-2	Stewart Warner
MC 832P	Motorola	DTL 932	Sperry
MC 832P	Motorola	PD 9932	Philco
MC 832P	Motorola	SN15 832N	Texas Inst.
MC 832P	Motorola	S 9323	Sylvania
MC 832P	Motorola	MIC 932	ITT
MC 832P	Motorola	HSC 932	Hughes
MC 832P	Motorola	CD2306E/832	RCA
MC 832P	Motorola	RM 932	Raytheon

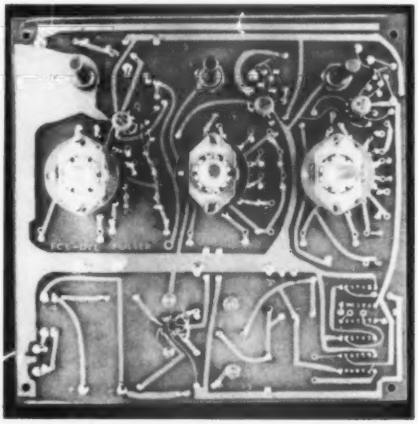
Interfacing *between* the ECL section and the DTL–TTL buffer is an MC1018P *translator* IC. This IC requires ground, +5V, and −5.2V for supply connections. A simplified circuit of the MC1018P is shown in Fig. 3 as used in the pulser. Of course, such a circuit *could* be built of discrete components, but not as simply and inexpensively as using the MC1018P. If the MC1018P is hard to find, the MC1018L may be used. It is the same "chip" in a *ceramic* case, and is being sold at a slightly higher price than the plastic unit.

The output section for the ECL compatible pulses is provided by an MC1023P. Although this IC is billed as a *clock driver*, it makes the best output stage of any of the MECL II series. This is true because of its exceptional ability to drive capacitive loads.

The regulated +5V and −5.2V are provided by a common power transformer and rectifier. Since the centertap of the transformer is grounded, the circuit may be considered as two full-wave rectifiers (one positive and one negative) across the same transformer. Of course, the diode configuration comes out the same as a full-wave bridge; so an IC bridge (HEP 175) is used.



Circuit board, parts side.



Circuit board. trace side.

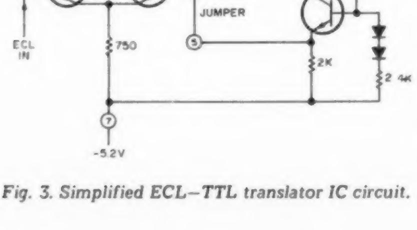


Fig. 3. Simplified ECL–TTL translator IC circuit.

The positive regulator is an MC1460R, an inexpensive IC that provides excellent regulation with few external components. The negative regulator is an emitter follower with a 5.6V zener and a germanium PNP transistor. Since the base-to-emitter drop of germanium transistors is about 0.3V, 5.6V minus 0.3V gives us close to the −5.2V required for the ECL–ICs.

Both the MC1460R and the HEP 232 (PNP power transistor) are diamond-shaped and meant to be fastened to a heatsink. They each have an aluminum bracket attached to them to fulfill this requirement for a dissipator.

The entire circuit of the pulser is built on an etched circuit board. In fact, the wafer switches are assembled so that the board is clamped into the switch assembly. The shafts of the switches are cut to 7/8 in. to extend out the same length as the pot shafts. The entire board is then mounted to a panel using 1-1/8 in. spacers. Some care must be exercised not to allow the spacers to short any of the traces of the circuit board to ground. This can be insured by using fiber washers between board and spacers. The one spacer in the power supply corner is intended to connect the board ground to the panel, so no fiber washer should be used at that corner.

All the components are mounted on the side of the board away from the panel, except the three HEP ICs. These three ICs were reverse-mounted to ease layout, allowing shorter trace lengths.

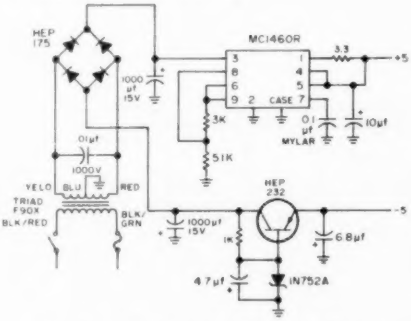

HEP
175
1000
µf
15V
MC1460R
3
8
6
9
2
CASE
7
1
4
5
3.3
+5
3K
51K
0.1
µf
MYLAR
10µf
.01µf
1000V
YELO
BLU
RED
TRIAD
F90X
BLK/RED
BLK/
GRN
1000µf
15V
HEP
232
-5
1K
6.8µf
4.7µf
IN752A

Fig. 4. Power supply for new ECL pulser.

The 7-7/8 x 7-7/8 in. panel is made to fit a Bud CD-1480 cabinet which has enough panel space for all the controls and jacks. The power transformer is mounted (off the board) inside this cabinet.

As to the DTL–TTL output capability of the pulser, it is dependent on the exact type of output stage. Each of the ECL outputs will drive 24 ECL gates (has an ECL fanout of 24). But the fanout of each of the two current-sinking logic outputs is as follows: MC832P – 24 DTL load units, SN7440N – 29 TTL (SN7400N series) load units, MC3025P – 19 MTTL III load units. The load units are not the same for these three current-sinking families, so it is best to use the type of output IC for the sort of family *you* use most. It is quite all right to use any of the types of current-sinking logic ICs with the pulser (no matter which IC is used in the output stage), but some reduction of fanout may be experienced with certain combinations.

Performance

The pulser will produce pulses (and delays) from about 50 ns to 30 ms. DELAY and PULSE switches each have six positions, and the variable control associated with each continuously varies each over at least ten-to-one. Pulse repetition

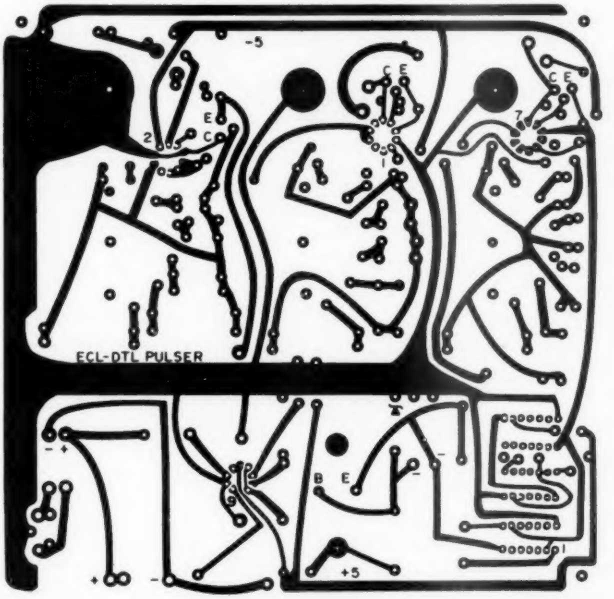

-5
C E
E
C
2
1
C E
7
ECL-DTL PULSER
- +
B E
+
-
+5
1

Fig. 5. PC layout of IC pulser.

rate is adjustable from about 0.5 Hz to 1 MHz with a six-position switch and variable control. The labeling of the three panel switches was minimal, with 200 kHz to 2 Hz (in that order, so that the period steps in the same direction as delay and pulse width) for the rep rate. These labeled frequencies correspond to frequencies *within* each switch position, not the center or either end point. The DELAY and PULSE switch positions were similarly labeled from 0.1 μs to 10 ms for simplicity.

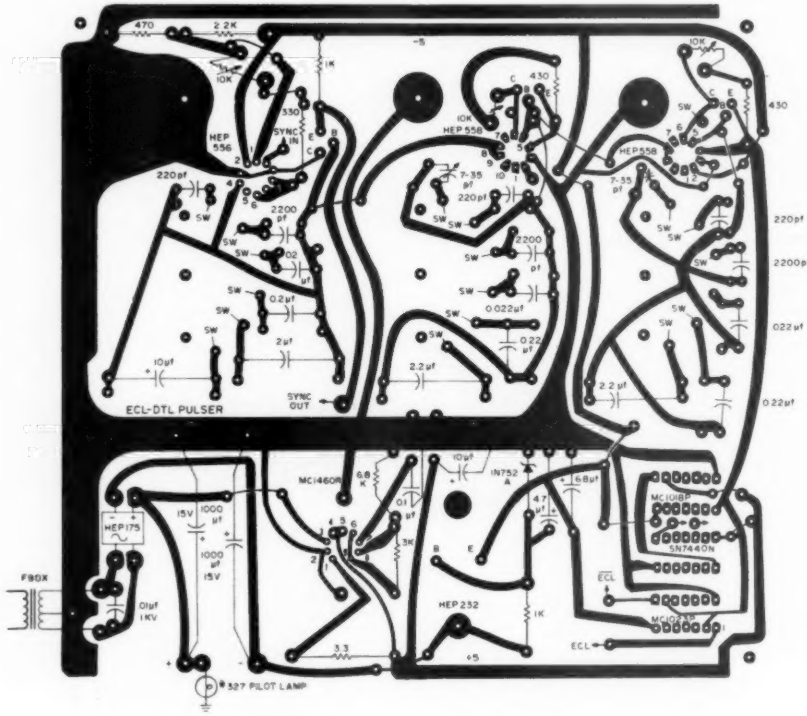

470
2.2K
10K
1K
-5
330
SYNC IN
HEP 556
220pf
SW
2200 pf
.02 μf
0.2μf
2μf
10μf
SYNC OUT
ECL-DTL PULSER
430
10K
HEP 558
7-35 pf
220pf
2200 pf
0.022μf
0.22 μf
2.2μf
HEP558
220pf
2200pf
022μf
0.22μf
F80X
HEP175
.01μf 1KV
15V
1000 μf
MC1460R
6.8 K
10μf
.01 μf
3K
IN752 A
68μf
47 μf
MC1018P
SN7440N
ECL
MC1023P
HEP 232
1K
3.3
+5
ECL
#327 PILOT LAMP

Fig. 6. Component placement (etched side of board shown).

Construction

The entire pulser is built on an etched circuit board, including the power supply, whose circuit appears in Fig. 4. Figure 5 is a half-scale copy of the board.

Since the etched board method has been used, some specialization in components is necessary. The Cornell-Dubilier BR1000-15 filter capacitors are physically smaller than most other brands of the same capacity and voltage rating, and so are best used. Similarly, the switches are Centralab PA-1 and PA-300 combinations, and the two variable capacitors are Trush S-Tri ko 03 types. The IC sockets were HEP 451 for the round-can types and Methode M1141 for the dual-inline types. Figure 6 is the layout of all components on the board.

Both circuit board and a kit of parts are available from Project Supply Co., Box 555, Tempe AZ 85281.

Bibliography

1. Olson, H., *A Pulse Generator for the Amateur*, 73, Nov 67.
2. Renschler, E., *Design of Monostable Multivibrators Using MECL Integrated Circuits*, Motorola Application Note AN233.
3. Texas Instruments, *Integrated Circuits Catalog 1967–68*.

. . . W6GXN ■

Martin B. Weinstein
27 N. Court St. # 335
Athens OH 45701

a DC ISOLATOR for phones

With the advent of recent court decisions which allow attachments to the telephone lines on a noninterfering basis, several amateurs have raised the question of just how they can avoid interference with the telephone lines. Aside from the limitations on frequency and amplitude excursions (these can be automatically limited, as in the Ives[1] circuit), there is a strict requirement forbidding the introduction of dc bias to the telephone lines. Most of the simple amateur phone patches, for example, take no precautions against unwanted dc. Other attachments to the lines may also be offenders.

The circuit shown in Fig. 1 provides a dc-isolated telephone terminal and allows operation of a standard telephone from the isolated terminal by providing talk current to the handset carbon microphone. The design is intended to handle incoming calls only.

Theory

The heart of the unit is isolating capacitor C1. The 0.5 μF value has experimentally proved critical, but the capacitor specified is easy to find and costs less than a buck. S1, the "isolate–normal" switch, disables the unit.

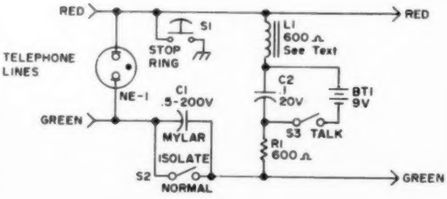


Fig. 1. Dc isolator circuit.

L1, C2, and R1 together endeavor to synthesize the characteristics of a balanced telephone line. The values given were chosen because they look good, they're easy to get, and they work without causing trouble.

Neon lamp NE1 provides indication of ring. S1, connected to an earth ground, stops the ringing. In a standard telephone, the cradle (hang-up) switch cancels the ring by providing dc continuity. Whereas the purpose of this isolator is the avoidance of dc continuity, the earthing of the high line was chosen as a workable alternative.

Construction

There are less than a dozen parts in the isolator. There is plenty of flexibility available in the actual physical layout.

The NE1 pilot light can be almost any neon pilot light, and does not require a current-limiting resistor. Certain individual bulbs have a tendency toward oscillation, but this can be avoided if the bulbs are first aged in other equipment.

L1 is a 600Ω inductor. Slide-rule figures for voice frequencies show an inductance of 30–160 mH. The most economical way to obtain 600 Ω is to use half of a small transistor-type audio transformer. Be sure to place a resistor of matching impedance across any unused windings. 75–100 mH chokes or 88 mH toroids can be tried, if desired.

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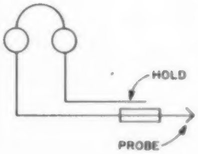


Fig. 2. Connect one wire of headphone (high Z) to each of the phone wires while holding the second headphone lead in your hand. The talk wire with louder hum is one marked "red" in schematic.

B1 can be 6–12V. Most of the units already in operation use 9V batteries; these begin to degrade noticeably in four to five months with a marked reduction in loudness in the talk circuits. The six-pack holders for penlight cells give somewhat better performance and last considerably longer. One elaborate unit was designed with a zener-regulated supply trickle-charging a diode-isolated battery which doubled as an output ballast.

The unit may either be built into a small box and placed in line with your telephone, phone patch, tape recorder, or whatever you have, or if you have a surplus telephone, you can build the unit right into it.

Operation

To answer the phone when the isolator is in-circuit (S2 open, in the isolate position), momentarily close S1 (stop ring) to stop the ringing, then close S3 (talk) to provide talking current.

The isolator performs another trick, one quite useful to those of us with mothers-in-law. By answering the telephone on "isolate" without hitting the "stop ring" switch or activating the talk circuit we can hear the party calling us before the telephone is actually answered.

One word of caution: Use the isolator *only* on calls from local telephones; its use on long distance (or for that matter, pay phone) calls will *not* allow the call to be properly registered on the telephone company's automatic billing equiment. THIS CONSTITUTES FRAUD AGAINST THE TELEPHONE COMPANY and does not allow proper operation of telephone equipment, which is precisely what this unit was designed to avoid. . . .Weinstein■

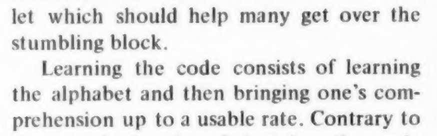
1. Ives, Ronald L. "A Deluxe Hybrid Phone Patch," *CQ*, November, 1966.

New Hope For Learning The Code

The Novice license has reduced ham theory and regulations to a manageable size, but even at 5 words per minute, the code still prevents many people from getting their ticket. A young firm in Massachusetts has come out with a new booklet which should help many get over the stumbling block.

Learning the code consists of learning the alphabet and then bringing one's comprehension up to a usable rate. Contrary to the standard rule of learning the code solely by sound, *The ABCs of Morse Code* uses modern educational theory to teach the code by sight and word association. Using childishly simple drawings, the unknown code letter is associated with a common word-picture. The figure shows a sample page from the book.

Amazingly, within two hours people really can learn the code. We tried the book on some of the non-ham staff at 73, and we were amazed. In half an afternoon, these staffers were writing notes back and forth in code and slowly copying messages. Emperor Imponderable Morse had been shown in his nakedness. He was conquerable.



F

FOX

F
sounds like
DIT DIT DAH DIT
• • — •

F is
••—•

FILL IN THE SYMBOLS	
A •—	
B —•••	
C —•—•	
D —••	
E •	
F	

Fig. 1. Sample page from the book shows the simple word-picture-code-letter association.

We are not saying that in two hours you can take your Novice or Technician test. This course is only a first step. A good tape or record course should be used to gain a facility with the letters. What this course does, however, is to destroy that widespread myth that the code is impossible or that the only way to code mastery is through tedious practice. When you are sending messages back and forth after an hour, it is pretty hard to convince yourself that the code is difficult.

The $1.75 for this booklet includes the free self-confidence, myth destruction, and hope.

Many say that learning the code visually cripples future attempts at increasing speed. Future growth with this method may be a little slower but will probably depend more on the desire to get the General or to get out of the 80-meter Novice ghetto than on the original method used to learn the code. Once you hold your Novice or Technician license you can ragchew about the best way to increase your speed – but you'll be doing this ragchewing over the air – and not on 11 meters.

The ABCs of Morse Code is available for $1.75 by mail from tech/media, 5 Central Square, Stoneham MA 02180. Order a dozen or more and the price drops to a buck apiece.

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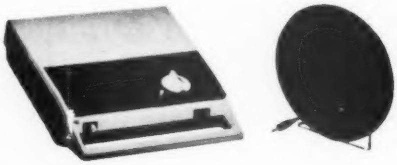
73 LOOKS AT THE ASTRO-MIKE

Bell & Howell has come out with a combination cassette tape recorder and parabolic mike that may tickle your fancy. Of course, if you've never had the yen to record bird songs and things like that, perhaps you've never felt the need of such a contraption.

It is nice to be able to take the recorder out in the fields and woods and tape some of the birds and other nature noises. The parabolic mike lets you do this without picking up all of the extraneous noises that otherwise would mar the recording.



You can have fun recording sports with it too, and even conversations that are far enough away so the people would never suspect that you are taping them. It is great for recording concerts and entertainers. If you've tried to record things at a distance with a regular tape recorder you know by now how terrible the results are. That comedian on stage down there is drowned out by the talk around you and the rustle of the audience.

The set costs $54.95 for B&H. It's called an Astro-Mike kit.

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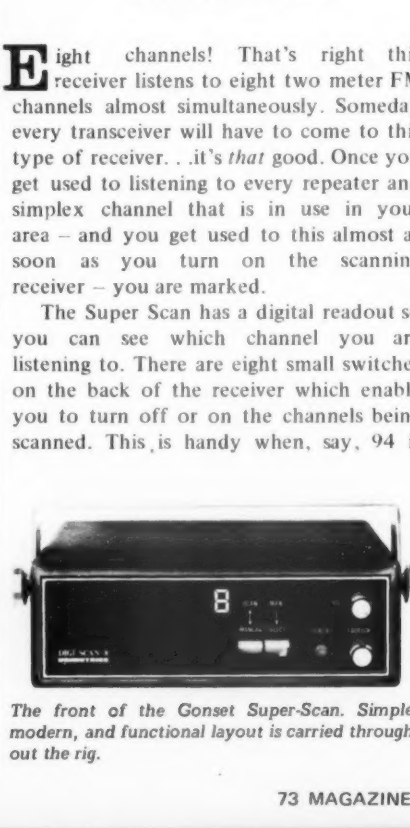
73 Tests the Gonset Super Scan Receiver

and blows its mind!

Eight channels! That's right this receiver listens to eight two meter FM channels almost simultaneously. Someday every transceiver will have to come to this type of receiver. . .it's *that* good. Once you get used to listening to every repeater and simplex channel that is in use in your area – and you get used to this almost as soon as you turn on the scanning receiver – you are marked.

The Super Scan has a digital readout so you can see which channel you are listening to. There are eight small switches on the back of the receiver which enable you to turn off or on the channels being scanned. This is handy when, say, 94 is



The front of the Gonset Super-Scan. Simple, modern, and functional layout is carried throughout the rig.

busy and you want to keep an ear peeled to the other channels. By switching off the 146.94 MHz position, the receiver will scan all but that channel.

The automatic scanner searches the eight channels in a little over a half a second, so not much gets by you. There is a front panel switch so you can turn off the scanner feature and switch channels manually.

Also on the front panel are the usual squelch and volume control. The power on-off switch is a push button instead of the volume control switch. This is nice because you don't have to turn off the squelch and check the volume every time you turn the receiver on.

The receiver is powered from either 12V dc or 115V ac, which is a very handy feature. The change is made just by switching power cords. Powering twelve-volt equipment can be a misery when you want to use it in the ham shack. Not many of us have an extra twelve-volt power supply that is quiet enough to run transistor equipment. One of these days we may build a power supply to run mobile equipment, but in the meantime we get by with a small wet battery (robbed from a Heath Boonie Bike) and a battery charger to keep it alive.

One very nice feature of the Gonset Super Scan is that it is shielded well enough to operate even with nearby transmitters perking. Some of the other scanning receivers just collapse when a transmitter is turned on in the vicinity. This has been annoying at hamfests and conventions where it is particularly nice to be able to listen to as many different channels as possible. Solid state receivers like this are particularly sensitive to strong rf, so Gonset has done a much better than average job of designing in this receiver.

There is a small speaker built into the receiver plus a jack in the back for a remote speaker if something more substantial is desired.

Mobile mounting hardware is included with the unit. This is just the thing to add to the car for the ham that has almost everything and wants to make it everything.

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New
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What's a battery-boost regulator? I wondered, too, so I asked Mark Products Company to send one along so I could find out. From the photographs, it appeared to be a power inverter although its function seemed to be more of a constant voltage device. Even more interesting, to me, was how such a unit could benefit the mobileer.

Turns out the new Mark entry, designated Model BBR-1216, is a solid-state direct current regulator which provides an extremely stable, constant voltage output to ham, Citizens Band and business radio transceivers – thus providing optimum power output on "transmit" and improving receiver sensitivity significantly.

To appreciate this unit's value, however, it has to be conceded that the performance of any solid-state communications equipment – and particularly FM gear – is closely dependent upon the supply voltage. Output power of your transmitter varies greatly as the supply voltage changes, and the overall receiver sensitivity and gain increases as the input voltage furnished by your car's electrical system is increased.

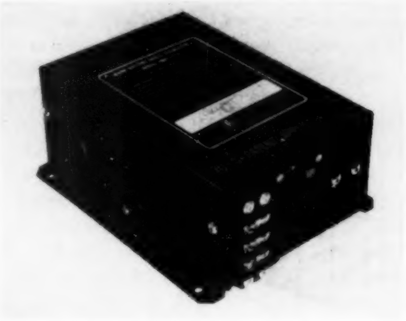
Why Problems Occur

If your automobile is anything like mine, quite large loads are placed upon its electrical system supply: the headlights, air conditioner, and a great number of accessories draw large currents from the battery.

by Robert M. Brown

Boost Regulator

As a result, the supply voltage to mobile communications equipment can vary from as low as 11 volts to around 16 volts. If, in an attempt to guarantee a high system voltage, the alternator-regulator system is set at a high level, there is serious danger of burning up the battery – and in all cases battery life is shortened.



Mark Products Battery-Boost Regulator model BBR-1216.

What Mark's Battery-Booster Does

According to Mark's engineering staff, the BBR-1216 was developed as an interface device between the automobile battery and the communications transceiver. But what actually happens and what value is it?

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I found the BBR-1216 provided a significent boost in range of communication with our two meter FM unit in the car. This came about as a result of increased power and improved receiver performance. Not immediately appreciated, however, is the fact that the unit also acts to protect the transceiver from the destructive effects of electrical system voltage surges.

Installation – Set and Forget

After locating a suitable flat surface for mounting on the car's firewall, I marked hole locations using the regulator as a template. With a #32 twist drill, the next step was to drill the four holes and mount using sheetmetal screws thoughtfully supplied for these purposes by the manufacturer.

The simple interconnections are best made per diagram supplied with the unit. The heaviest practical wire size should be employed; I used about eight feet of 16 AWG insulated, making direct connection to the car's battery.

If you plan to install one of these dandy devices, *do not* operate it from a battery eliminator, etc. Such units running from the 117V ac line do not have sufficient capacity to supply the necessary peak currents. The BBR-1216 has been designed for use with lead-acid storage battery systems only. Mark engineers, however, suggested that if one must operate from some kind of battery eliminator, it is necessary to place at least 30,000 mF of electrolytic capacitance across the battery eliminator to provide for leak currents. Possible solution: you can run the BBR-1216 from a 12V dc storage battery on the bench and a battery charger may be "floated" across the battery at all times when the BBR-1216 is operating.

In hookup, proper observance of polarity must be foremost in mind when connecting the unit to the battery. Negative ground must be used or a transistor will blow out! (Incidentally, improper polarity voids Mark's otherwide excellent warranty).

A feature I appreciate is that both input and output fuses are mounted inside the well-constructed unit (6 ampere, 3AG is the input; 3 ampere, 3AG is the output).

Opinion

It's not often I make a blanket endorsement of anything. In fact, this will probably be a first. Yet I feel the Mark Battery-Boost Regulator represents a significant advance in the state-of-the-art for two-way solid-state communications equipment. In fact, it's my opinion the unit should be employed in every mobile installation to insure that the equipment always operates at maximum design effectiveness.

Mark Products Company is located at 5439 West Fargo, Skokie, Illinois 60076.

Mark Model BBR-1216
Technical Specifications

Input voltage: 11–15V dc.

Output voltage: Preset at the factory for 15.5V dc. May be field adjusted by means of internal adjustment for any output voltage from 12 to 16V dc.

Output Current: Up to maximum of 2 amperes. Output is regulated to deliver preset voltage from no load up to this maximum current drain.

Solid-state devices: Thirteen; 10 transistors, 2 diodes, 1 zener diode.

Fuses: One 6A input and one 2A output. Note: Input current drains when operating typical solid-state 5-watt transceiver: Receive: 0.5A, Transmit (carrier): 1.8A, Transmit (modul.): 2.7A, Transceiver "off": 0.2A.

Control: On-off switch. When switch is "off," transceiver is directly connected to vehicle's battery.

Dimensions: 5 3/8 in. wide by 2 5/8 in. high by 7 in. deep.

Weight: Two pounds.

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☐	SN7430N	8 input gate	.45
☐	SN7440N	Dual 4 in. buffer	.45
☐	SN7441N	BCD-Nixie driver	1.95
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- ☐ Callbook 95, 122
- ☐ Communic. Spec. 99
- ☐ Cornell 118
- ☐ Crawford 120
- ☐ CushCraft 87
- ☐ Dow 123
- ☐ DX'ers 85
- ☐ DyComm 75
- ☐ EKY 111
- ☐ Epsilon 76
- ☐ Estes 56
- ☐ Fair 126
- ☐ Freck 51
- ☐ Gateway 124
- ☐ GBC 87
- ☐ G&G 125
- ☐ Goodheart 126
- ☐ Hal 99, 118
- ☐ Hale 111
- ☐ Hatry 56
- ☐ Henry 36,37
- ☐ Hi Par 111
- ☐ H&L 123
- ☐ James 120
- ☐ Jan 122
- ☐ Janel 111
- ☐ Jefftronics 123
- ☐ K Enterprises 55
- ☐ Lewispaul 124
- ☐ Logiconcepts 71
- ☐ Mann 49
- ☐ Mitch-Lan 111
- ☐ Motorola Cover IV
- ☐ National Cover III
- ☐ Pal 99
- ☐ Paradd 111
- ☐ Payne Radio 85
- ☐ Pickering 19
- ☐ Poly Paks 127
- ☐ R P Electronics 46
- ☐ R&R 121
- ☐ Saroc 51
- ☐ Saxton 29
- ☐ Sentry 63
- ☐ Standard Cover II
- ☐ S.W. Radio 126
- ☐ Telecomm 61
- ☐ Telrex 23
- ☐ Tower 123
- ☐ Vanguard 46, 118
- ☐ Vibroplex 111
- ☐ Wolf 120
- ☐ World QSL 123

73 Stuff
- Radio Bookshop 84, 85
- Gen'l Class Book 45
- Subscriptions 77
- FM Book 93
- Novice Class Book 103
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September 1971

SUN	MON	TUES	WED	THUR	FRI	SAT
			1	②	③	4
5	6	7	8	9	$\boxed{10}$	⑪
⑫	⑬	⑭	⑮	16	17	18
$\boxed{19}$	⑳	㉑	㉒	㉓	24	25
26	27	$\boxed{28}$	㉙	㉚		

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GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	7A	14	14	14
ARGENTINA	21	14	14	14	7	7	14	21	21	21	21	21
AUSTRALIA	21	14	7B	7B	7B	7	7	14	7B	7B	14A	21
CANAL ZONE	21	14	14	14	7	7	14	21	21	21	21	21
ENGLAND	7	7	7	7	7	7	14	14	14	14	14	14
HAWAII	21	14	7B	7	7	7	7	7B	14	21	21	21
INDIA	7	7B	7B	7B	7B	7B	14	14	14	14	7B	7
JAPAN	14	14	7B	7B	7B	7	7	7	7B	7B	7B	14
MEXICO	14A	14	7	7	7	7	7	14	14	21	21	21
PHILIPPINES	14	7A	7B	7B	7B	7B	7	14	14	14	7B	14
PUERTO RICO	14	7	7	7	7	7	14	14	14	14	14A	14
SOUTH AFRICA	14	7A	7	7B	7B	14	14A	21	21	21	21	14A
U. S. S. R.	7	7	7	7	7	7B	14	14	14	14	14	7B
WEST COAST	21	14	7	7	7	7	7	14	14A	14A	21	21

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7A	7	7	7	7	7	14	14	14	14
ARGENTINA	21	14	14	14	7A	7	14	21	21	21	21	21
AUSTRALIA	21	21	14	7B	7B	7	7	14	7B	7B	14A	21
CANAL ZONE	21	14	14	7	7	7	14	21	21	21	21	21
ENGLAND	7	7	7	7	7	7	7A	14	14	14	14	14
HAWAII	21	14A	14	7B	7	7	7	7	14	21	21	21
INDIA	14	14	7B	7B	7B	7B	7B	7A	14	14	7B	7
JAPAN	14	14	7B	7B	7B	7	7	7	7	7B	7B	14
MEXICO	14	14	7	7	7	7	7	14	14	14	14A	14A
PHILIPPINES	14	14	7A	7B	7B	7B	7	7	14	14	7B	14
PUERTO RICO	14A	14	7	7	7	7	14	14	14	14	21	21
SOUTH AFRICA	14	7A	7	7B	7B	7B	14	14A	21	21	21	14A
U. S. S. R.	7B	7	7	7	7	7B	7B	14	14	14	7A	7B

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	3A	7	7	7A	14	14	14
ARGENTINA	21	14A	14	14	14	7	7	14	21	21	21	21
AUSTRALIA	21	21	21	14	14	7	7	7	7	7	14A	21
CANAL ZONE	21	14	7	7	7	7	7	14	21	21	21	21
ENGLAND	7B	7	7	7	7	7	7B	7B	14	14	14	7B
HAWAII	21	21	21	14	14	7	7	7	14	21	21	21
INDIA	14	14	14	7B	7B	7B	7B	7B	14	14	7	7
JAPAN	14	14	14	7B	7B	7	7	7	7	7B	14	14
MEXICO	21	14	7	7	7	7	7	14	14A	21	21	21
PHILIPPINES	14	14	14	7B	7B	7B	7	7	7	14	7B	14
PUERTO RICO	21	14	7A	7	7	7	7	14	14	14A	21	21
SOUTH AFRICA	14	7A	7	7B	7B	7B	7B	14	14	14	14	14A
U. S. S. R.	7B	7B	7	7	7B	7B	7B	7B	14	14	7A	7B
EAST COAST	21	14	7	7	7	7	7	14	14A	14A	21	21

A = Next higher frequency may be useful also.
B = Difficult circuit this period.

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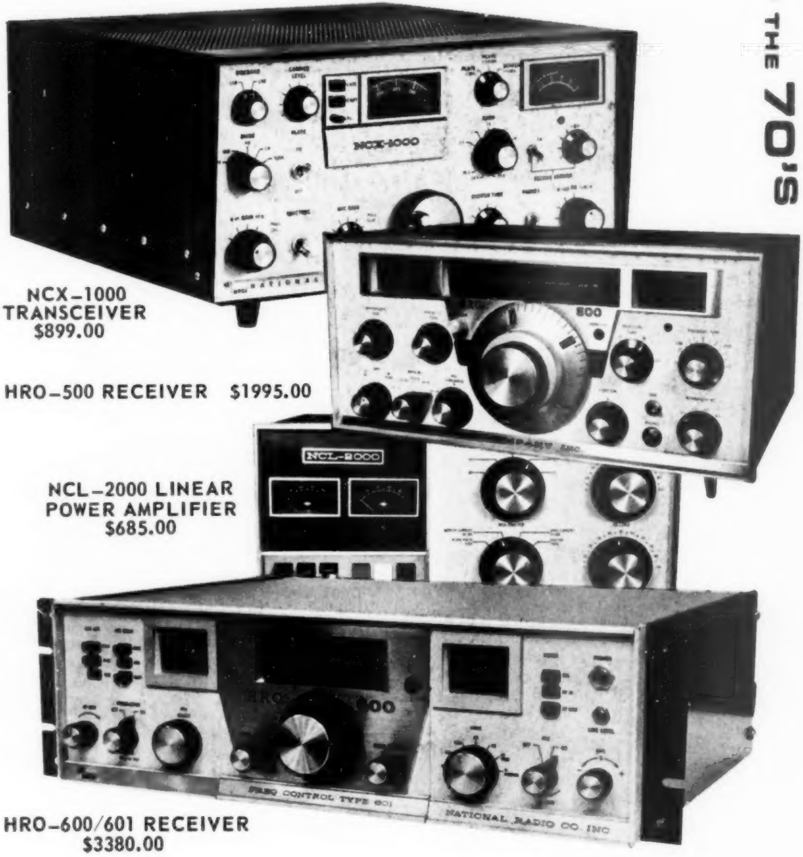
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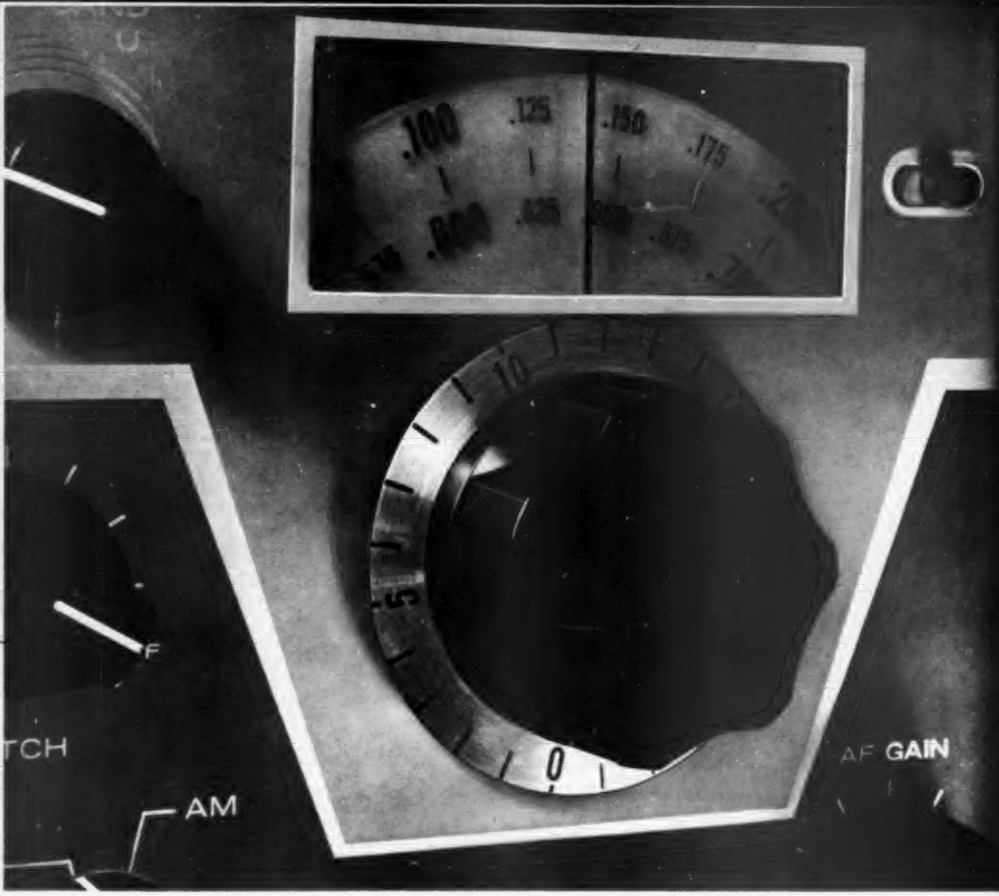

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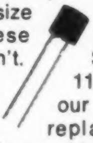

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